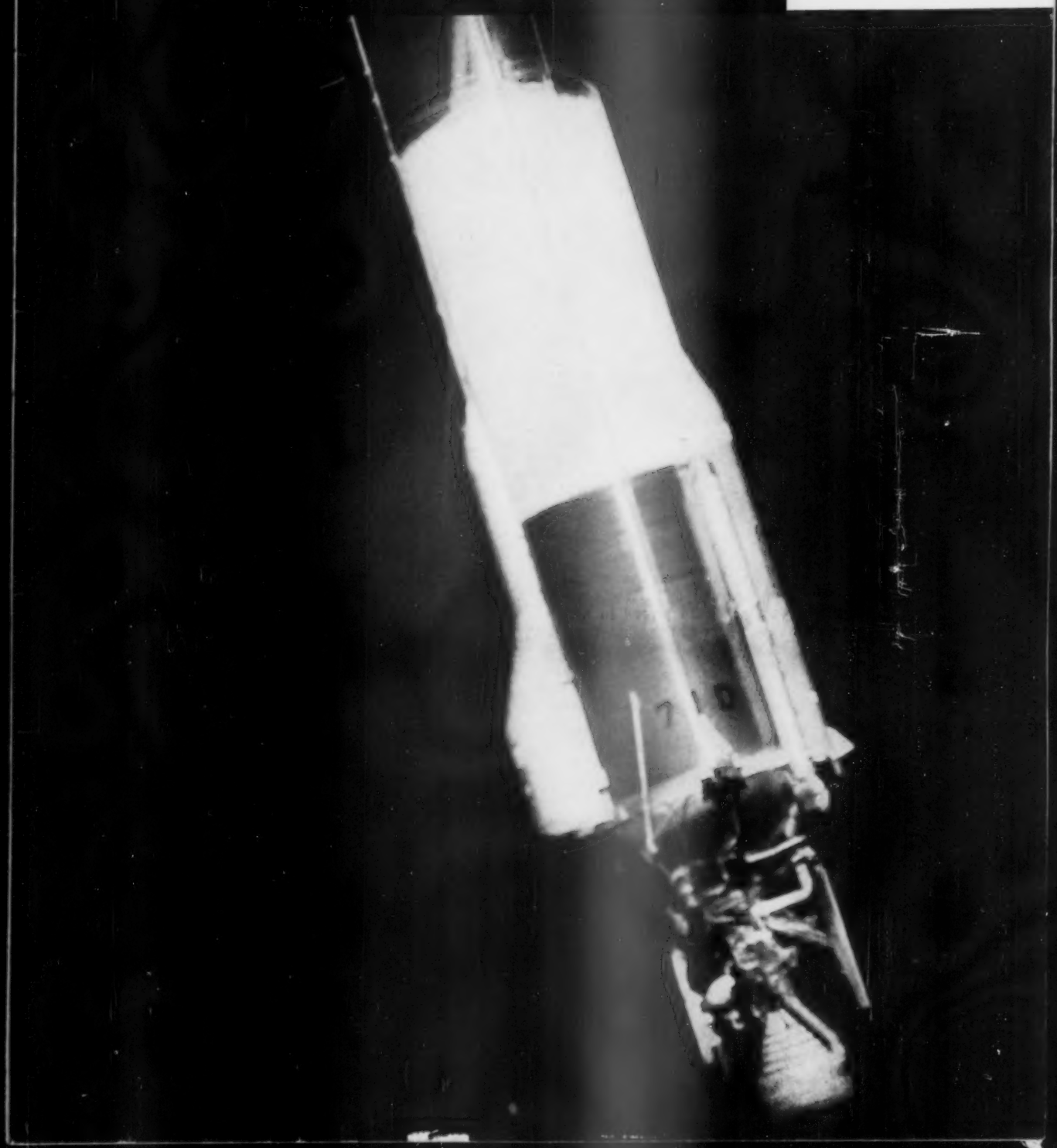
November 14, 1960

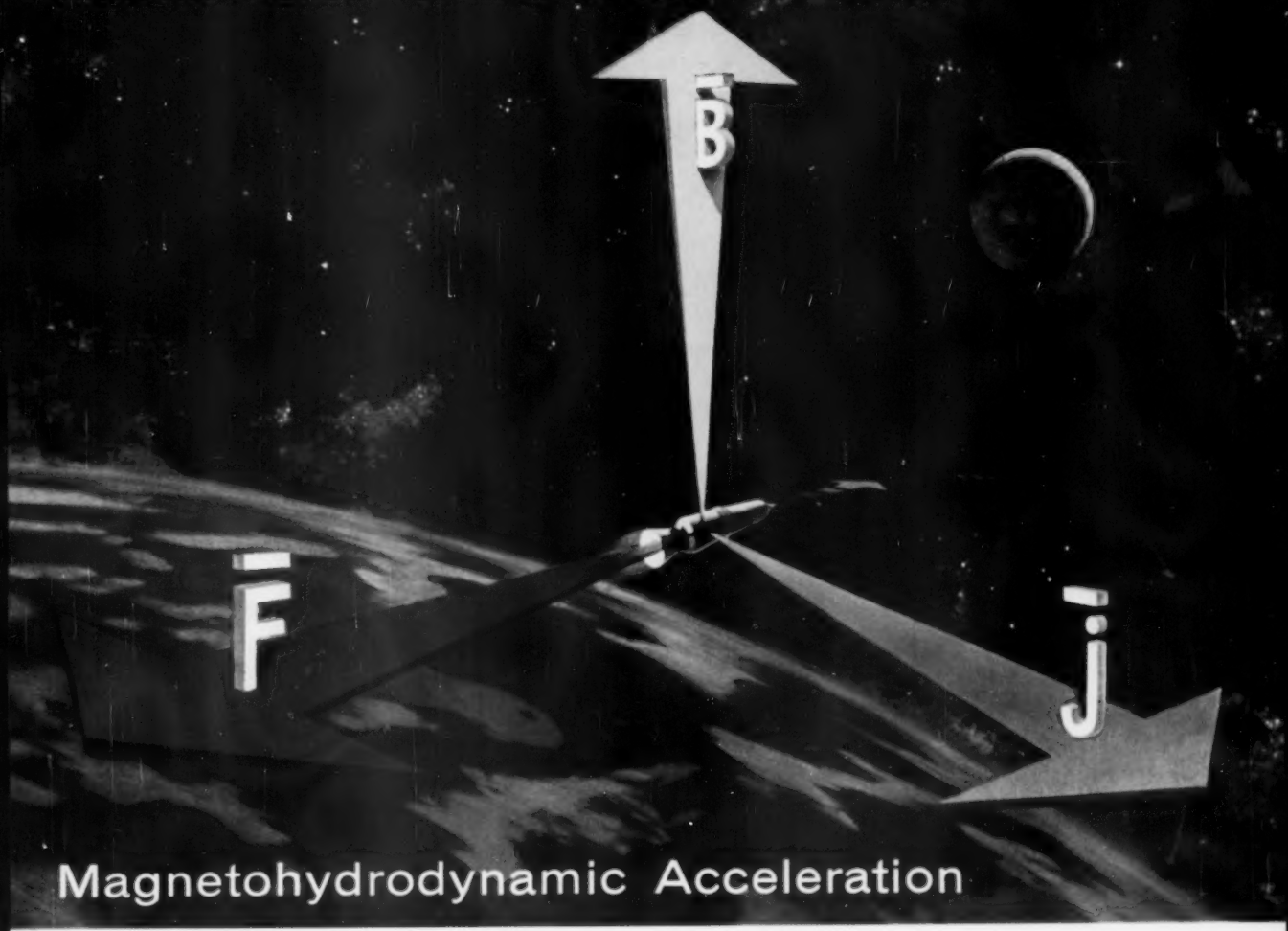
Aviation Week and Space Technology

B-58A 'Airliner' Proposed to Gain Supersonic Data

Convair Atlas
At 250-mi. Altitude



ANOTHER ASPECT OF THE MARQUARDT MISSION



Magnetohydrodynamic Acceleration

Preliminary investigation by ASTRO, Marquardt's division for research into the space-age, indicates that the magnetohydrodynamic ramjet offers unique and attractive performance characteristics. For example, once placed in a low altitude satellite orbit, this device can compensate for air drag or change the orbit position – all without the expenditure of propellant. The energy is supplied by a nuclear-electric power system which accelerates the captured air by steady magnetohydrodynamic (jxB) forces thus producing the propulsive force.

The accelerator of the MHD ramjet works in much the same way as an electric motor. A steady electric current (j) is passed through a conductor (ionized air) in the presence of a magnetic field (B). This combination of fields exerts a magnetohydrodynamic body force (F) on the ionized air which drives it to high velocity.

Another important application of the MHD accelerator is to the electrical rocket for use in an extra-terrestrial environment. In this application the propellant is supplied from a tank and ionized by an electric arc before passing to the magnetohydrodynamic accelerator.

ASTRO's continuing studies of magnetohydrodynamic acceleration typify but one aspect of The Marquardt Mission.

Creative engineers and scientists needed.

ASTRO DIVISION

THE Marquardt CORPORATION

CORPORATE OFFICES, VAN NUYS, CALIFORNIA

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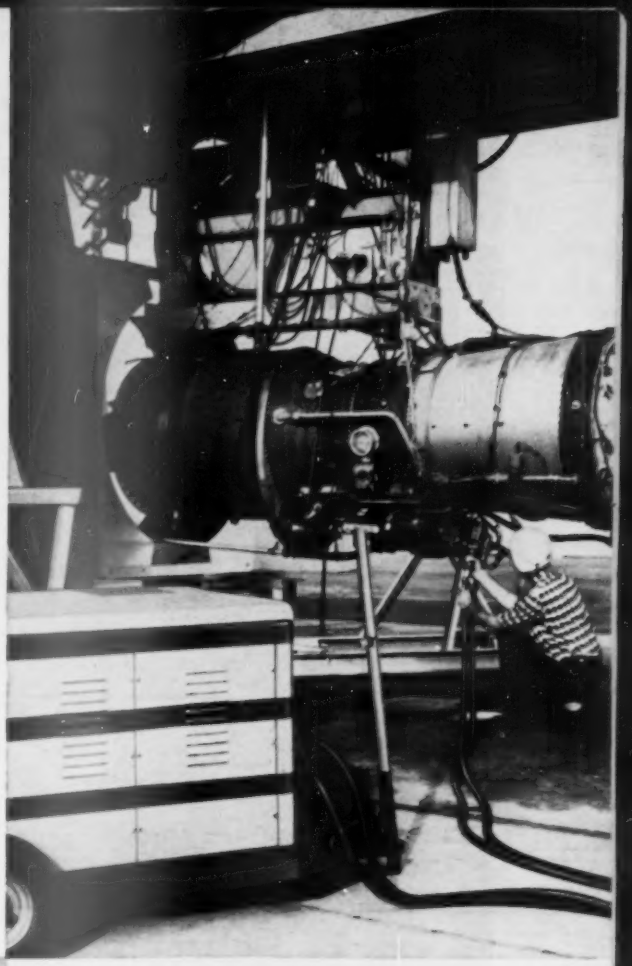
CAPABILITY
is spelled
h-y-d-r-a-u-l-i-c
s-t-a-r-t-i-n-g

In technology and facility, Vickers continually matches your need

Auxiliary power units pioneered for aircraft turbine starting by Vickers combine high efficiency with minimum size and weight for the power delivered. Because starter characteristics are closely matched to engine requirements, they provide smooth, steady acceleration of the engine through the firepoint range giving the best possible chance of proper "lighting off" and avoiding aborted starts.

Dual-purpose units developed by Vickers as an outgrowth of pioneering work in hydraulic starting offer further benefits in weight saving. These units are used as a motor in engine starting, as a pump to supply accessory power during normal operation. Reduced cost and ground support requirements plus increased versatility and simpler remote area operation are other major benefits. Write for Bulletin A-6001.



PROVED PERFORMANCE of hydraulic starting for jet engines is demonstrated by this cart that has performed more than 2,500 trouble-free starts in a 2-year period. Cart size is due to divergent requiremegts of three different engines. Prime mover power requirement is only 25% of that needed for other starting methods due to inherent high efficiency of the hydraulic transmission.

JET PROP STARTING demonstration uses engine-mounted starter motor and ground cart power supply. Starter cutout speed of approximately 8,000 rpm was reached in 34.5 to 40 seconds during series of observed test starts.

MULTI-PURPOSE PUMP MOTOR (left) is pump when driving hydraulic starter becomes motor during normal flight to drive 15 KVA generator. **HELICOPTER STARTER** (right) is 35 hp unit, starts 1,900 shaft hp engine readily.

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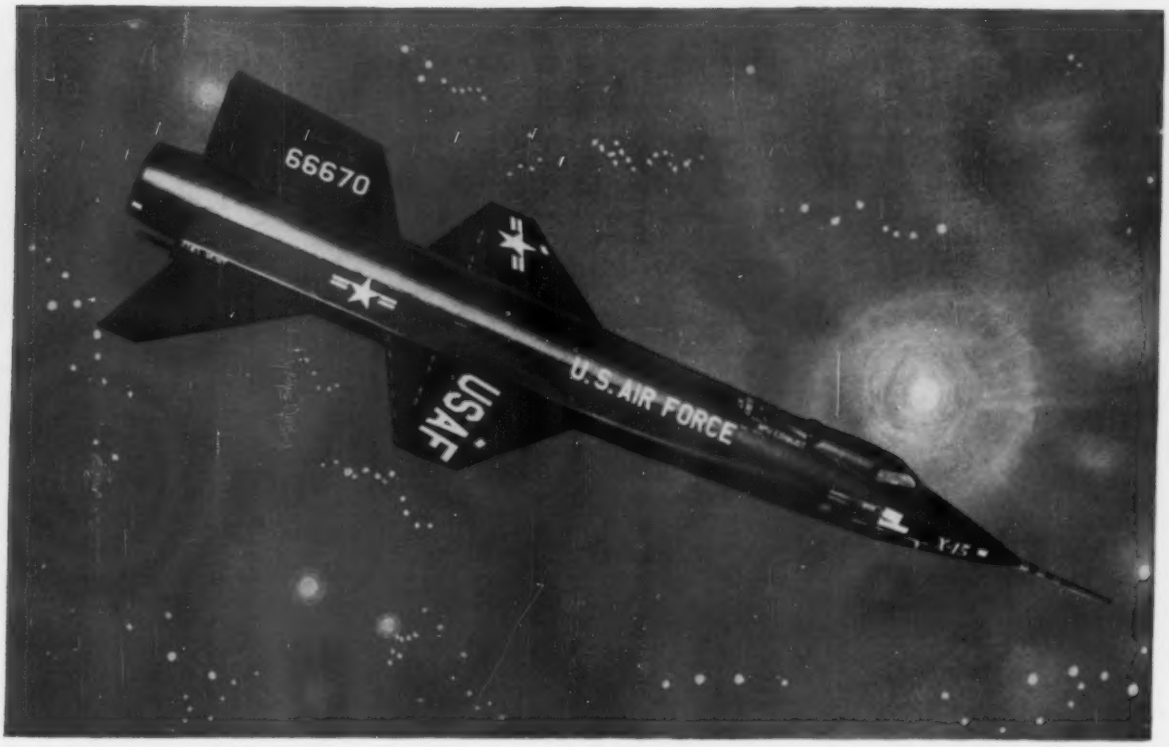
SILICONE NEWS from Dow Corning

Beyond All Others...



Here's Why Silastic Is Used In Man's Probes Into Space!

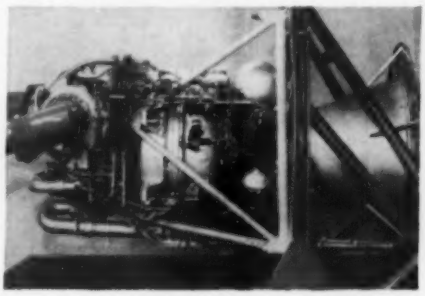
By going faster and farther into space, the X-15 adds to our rapidly expanding knowledge about the chances of men and materials surviving the trip out—*and back*. That's why only proven materials are selected. One of those is Silastic® LS, the Dow Corning fluorosilicone rubber that resists oils, fuels and solvents.

Engineers of Reaction Motors Division of Thiokol Chemical Corporation specified an accumulator diaphragm of Silastic LS for the X-15's XLR-99 engine. The accumulator provides oil at a constant pressure to the lube oil pump. Gaseous nitrogen under pressure is the source of stored energy, and is separated from 4-11V Halocarbon oil by the Silastic LS.

Here are diaphragm requirements the designers established as essential: An elastomer flexible from —80 to 200 F (Silastic LS maintains its flexibility from —80 to 500 F); compatible with the lube oil at low and elevated temperatures (Silastic LS has little swell or change in durometer readings after immersion in many hot oils, fuels and some hydraulic fluids); will not contaminate lube oil (Silastic LS has no plasticizers or additives which can contaminate by leaching).

Silastic LS... the only elastomer to meet all these requirements... helps the X-15 as it knocks on the door to outer space.

Shown below is the XLR-99 rocket engine. The lube oil accumulator is the light weight type... made possible by the diaphragm of Silastic LS... instead of the heavy, bulky piston type. Parts of Silastic can be engineered to meet your specific needs by your rubber fabricator.



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AVIATION CALENDAR

Nov. 29—General Freight Traffic Management Seminar for Army, Navy, Air Force and Marine Corps transportation personnel of the Southwestern Traffic Region, Adolphus Hotel, Dallas, Tex.

Dec. 5-8—15th Annual Meeting and Astronautical Exposition, American Rocket Society, Shoreham Hotel, Washington, D. C.

Dec. 6-8—Annual Meeting, National Aviation Trades Assn., Oklahoma-Biltmore, Oklahoma City, Okla.

Dec. 6-8—10th Annual Meeting, National Air Taxi Conference, Oklahoma Biltmore Hotel, Oklahoma City, Okla.

Dec. 12-15—Atomic Industry Exhibition, California Masonic Memorial Temple, San Francisco, Calif., concurrent with the Atomic Industrial Forum's Annual Conference (Fairmont Hotel) and the American Nuclear Society's Winter Meeting (Hotel Mark Hopkins).

Dec. 13-15—Tenth Annual Eastern Joint Computer Conference, Hotel New Yorker and Manhattan Center, New York, N. Y.

Dec. 16—Army Aviation Contract Services Symposium, National Aeronautical Services Assn., Mayflower Hotel, Washington, D. C.

Dec. 17—24th Wright Brothers Lecture, Natural History Bldg., Smithsonian Institution, Washington, D. C.

Dec. 26-31—127th Meeting, American Association for the Advancement of Science, New York, N. Y.

Dec. 28-30—Seventh King Orange International Model Plane Meet, Miami, Fla.

Jan. 9-11—Seventh National Symposium on Reliability and Quality Control, Bellevue-Stratford Hotel, Philadelphia, Pa.

Jan. 9-13—International Congress and Exposition, Society of Automotive Engi-

(*Continued on page 6*)

AVIATION WEEK and Space Technology

November 14, 1960

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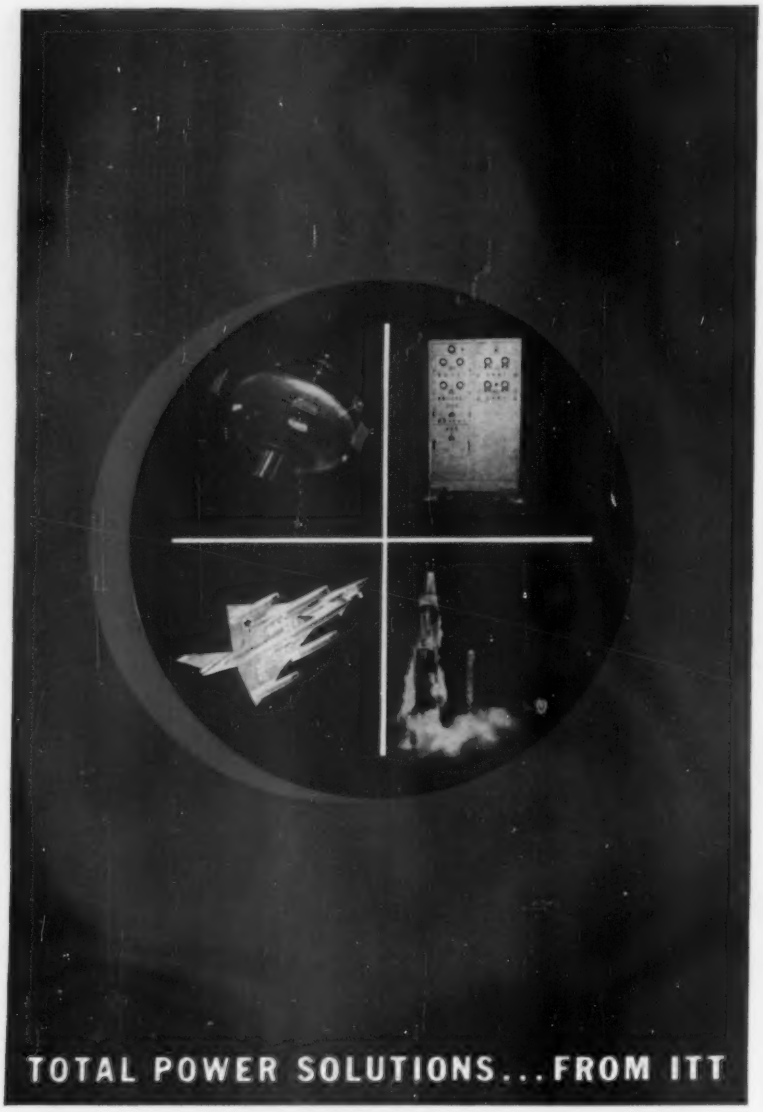

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AVIATION CALENDAR

(*Continued from page 5*)

neers, Cobo Hall, Detroit, Mich.

Jan. 16-18—Seventh Annual National Meeting, American Astronautical Society, Dallas, Tex.

Jan. 17-19—Winter Instrument-Automation Conference & Exhibit, Instrument Society of America, Jefferson Hotel and Kiel Auditorium, St. Louis, Mo.

Jan. 23-25—29th Annual Meeting, Institute of the Aeronautical Sciences, Hotel Astor, New York, N. Y. Honors Night Dinner, Jan. 24.

Feb. 1-3—Second Winter Military Electronics Convention, Institute of Radio Engineers, Biltmore Hotel, Los Angeles.

Feb. 1-3—Solid Propellants Conference, American Rocket Society, Salt Lake City.

Feb. 15-17—International Solid-State Circuits Conference, Institute of Radio Engineers, University of Pennsylvania campus and Sheraton Hotel, Philadelphia.

Mar. 5-9—Sixth Annual Gas Turbine Conference and Exhibit, American Society of Mechanical Engineers, Shoreham Hotel, Washington, D. C.

Mar. 9-10—Second Symposium on Engineering Aspects of Magnetohydrodynamics, University of Pennsylvania, Philadelphia.

Mar. 9-10—Flight Propulsion Meeting, Institute of the Aeronautical Sciences, Cleveland, Ohio (classified).

Mar. 12-16—Aviation Conference, American Society of Mechanical Engineers, Statler-Hilton, Los Angeles, Calif.

Mar. 13-15—Flight Testing Conference, American Rocket Society, Los Angeles.

Mar. 13-16—Test, Operations and Support Conference, American Rocket Society, Biltmore Hotel, Los Angeles, Calif.

Mar. 16-18—Fifth National Conference on Aviation Education, Mayflower Hotel, Washington, D. C.

Mar. 20-23—International Convention, Institute of Radio Engineers, Coliseum and Waldorf Astoria Hotel, New York, N. Y.

Mar. 20-24—1961 Western Metal Exposition, American Society for Metals, Pan-Pacific Auditorium, Los Angeles, Calif.

Apr. 4-6—International Symposium on Electromagnetics and Fluid Dynamics of Gaseous Plasma, Polytechnic Institute of Brooklyn, Brooklyn, N. Y.

Apr. 5-7—Lifting Re-entry Vehicles: Structures, Materials & Design, American Rocket Society, Palm Springs, Calif.

Apr. 17-28—14th Technical Conference, International Air Transport Assn., Queen Elizabeth Hotel, Montreal, Canada.

Apr. 18-20—Symposium on Chemical Reactions in the Lower and Upper Atmosphere, Stanford Research Institute, Mark Hopkins Hotel, San Francisco, Calif.

Apr. 20-22—General Meeting, American Meteorological Society with the American Geophysical Union, Washington, D. C.

Apr. 26-28—Detonation & Deflagration Phenomena Conference, American Rocket Society, Palm Beach, Fla.

Apr. 30-May 4—Seventh National Aero-Space Instrumentation Symposium, Instrument Society of America, Adolphus Hotel, Houston, Tex.

May 22-24—National Telemetering Conference, Hotel Morrison, Chicago, Ill.

May 26-June 4—24th French International Air Show, Le Bourget, Paris, France.

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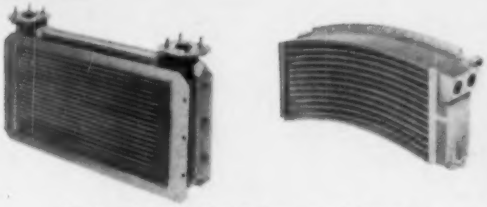

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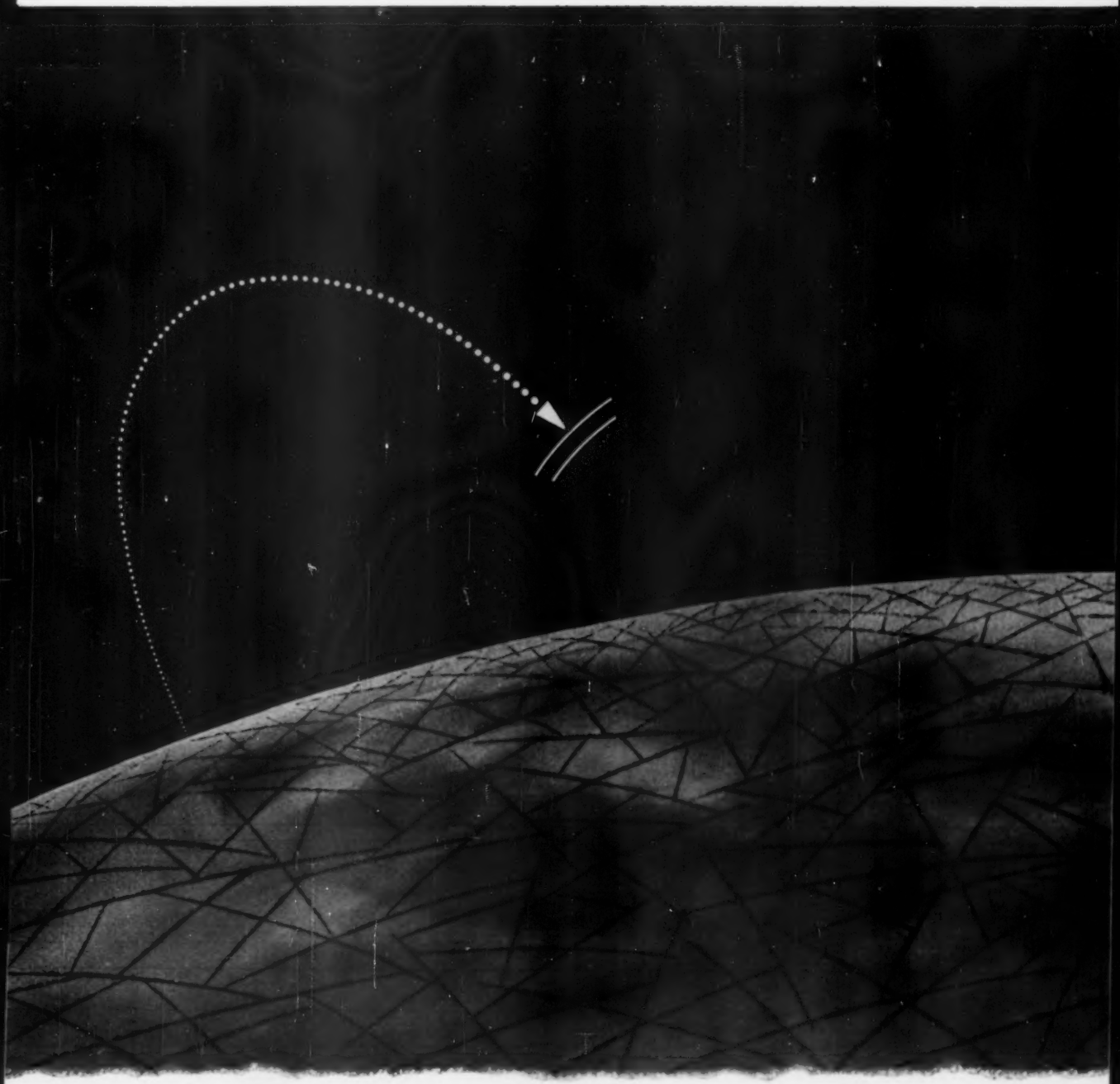
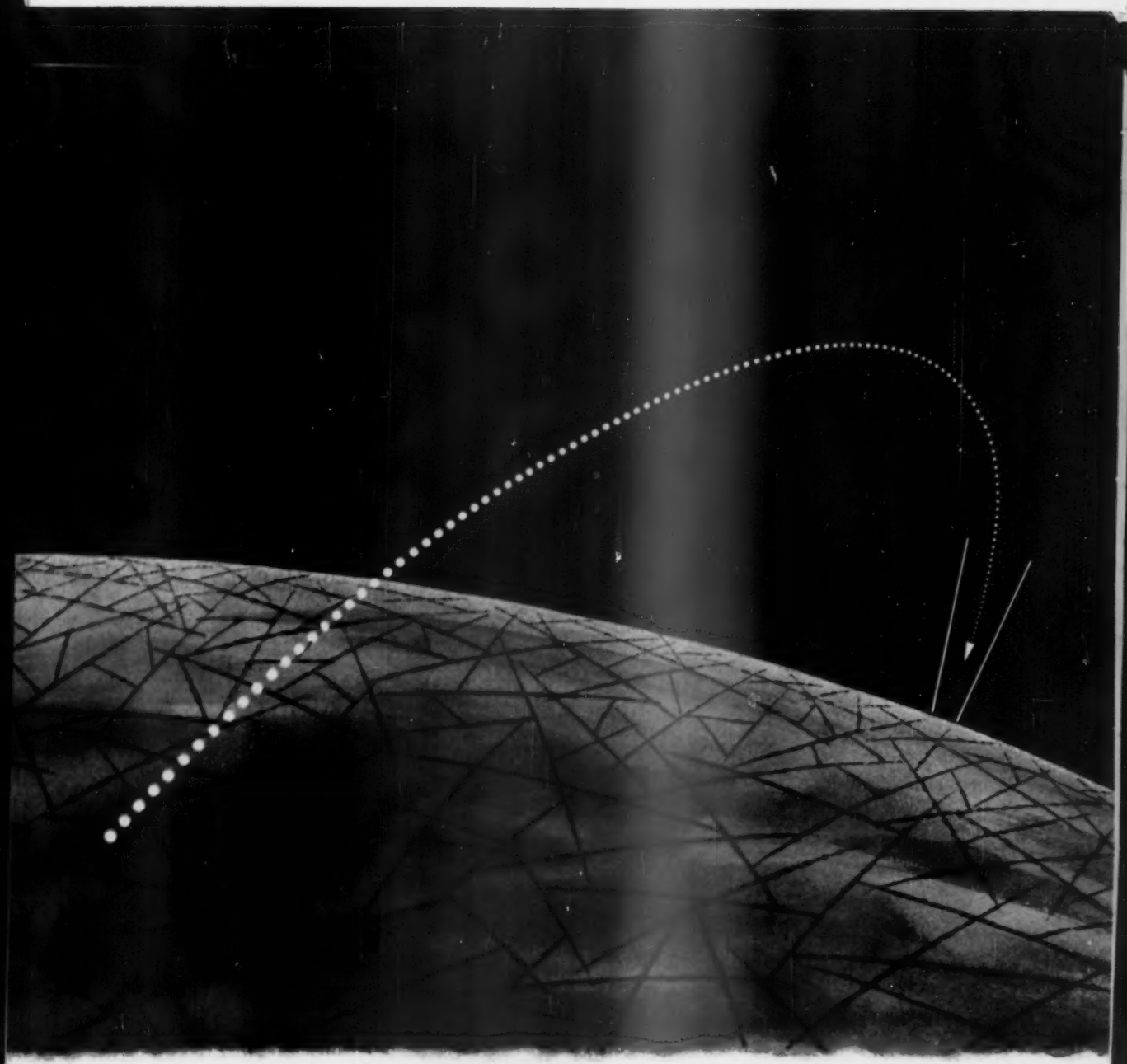


LORAL: Solving both sides of the

DETECTION: The time lapse from initial detection of an approaching missile to the latest possible moment for intercept is a very few minutes. Into that gap must go signal analysis and interpretation, programming of an anti-missile, and the intercept flight. Early warning is the first factor to be considered, and we have been active in bomber early warning for years, with airborne detection equipments now operational on many military aircraft. Now we are applying our experience to the study of missile early warning systems; using our background in data analysis and integration for: target location and tracking, programming the weapon to find efficient intercept paths, and creating unbreakable lock-on techniques. Can a lock-on *be* unbreakable? That leads us to the other side of the equation...

LORAL

Imprint of Integrity



missile equation

DECEPTION . . . Studies in enemy missile detection lead to studies in systems for our own missiles to evade detection . . . Penetration Aids. A ballistic weapon of current configuration cannot take evasive action in the terminal phase. To confuse enemy tracking networks, deception is necessary. What type deception? What systems are they using to detect us? Passive? Active? . . . Radar, IR, UV. One of our fields of research is finding means to combat these detection methods. We are working toward complete micro-miniaturized systems to sense, analyze, interpret, and counter; systems to eliminate as many hazards as possible to insure delivery of the weapon to the target.

If you are a senior scientist or engineer interested in helping to solve both sides of the missile equation, write LORAL Electronics Corporation, New York 72, New York.

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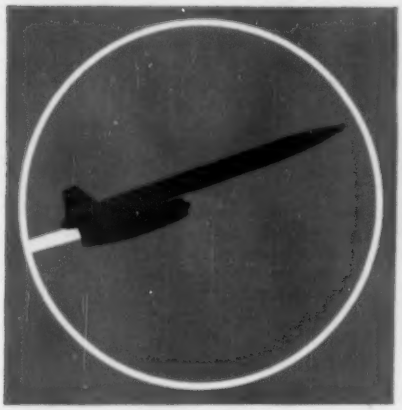
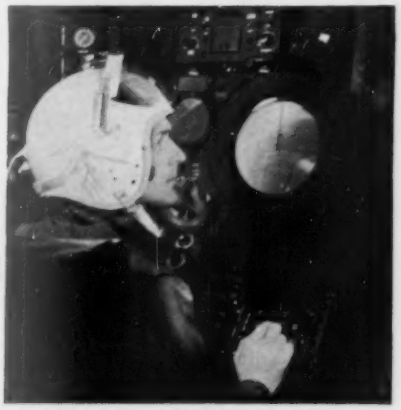
The elements of guidance and control:





Data Acquisition and Application Subsystems—IBM has proven capabilities to provide real-time man-to-machine and machine-to-machine elements of weapon guidance systems. In addition to the Bombing-Navigation system with its visual displays in the B-52, IBM also provides interface devices to apply this system to air-launched missile guidance. Federal Systems Division experience in air-based and ground-based guidance systems is proven in operation.

Data Communications Subsystems—The SAGE data processing system, heart of America's air defense network, embodies advanced communications devices and techniques required to filter and direct an enormous flow of data. Designed and built by the Federal Systems Division, the AN/FSQ-7, an advanced system in operation, embodies processing and communications power to direct defense operations as well as to guide missiles from remote sites.

Data Processing and Control Subsystems—Now in development, the Advanced Bombing-Navigation and Missile Guidance system is another example of IBM's "closed-loop" system capability. This system satisfies the operating requirements of high-speed, long-range weapon systems. Compact, reliable equipment such as this and Federal Systems Division's computer for the Titan missile guidance system are the result of IBM's vast background in data processing and control.

all systems capabilities of IBM

IBM's experience in data processing and data communications, supplemented by an extensive background in data acquisition, adds up to a three-way capability for developing, producing and integrating total automated systems. This capability is being advanced through continuing research in miniature high-speed devices for high-reliability guidance systems of the future.

Federal Systems Division, 326 East Montgomery Avenue, Rockville, Maryland IBM

HOW YOU CAN PUT TELEVISION TO WORK

A brief report on how to use KIN TEL closed circuit TV systems to cut costs, reduce errors, up efficiency

Today, hundreds of companies are solving a wide variety of business and industrial problems with KIN TEL closed circuit TV systems.

For example:

U.S. Steel uses a KIN TEL system to see inside open hearth furnaces.

The Los Angeles Department of Water and Power uses one for remote viewing of water-level meters.

Convair, Douglas, Lockheed, and Northrop all watch rocket tests with KIN TEL systems.

Westinghouse watches nuclear power reactor tests with one.

American Potash and Chemical monitors conveyor line and warehousing operations with one.

The San Francisco Naval Shipyard uses one to guard against pilferage.

These, and many other KIN TEL customers—both large and small—have discovered a significant fact: *Closed circuit television is no longer a novelty.* It's a proven, practical piece of equipment that, in many instances, pays for itself within a year. It's a modern, money-making piece of equipment that you can use in your business, in your plant, in your operation.

What Is a Kin Tel Closed Circuit TV System?

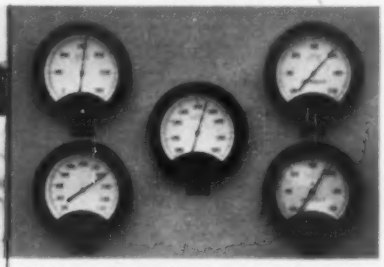
The basic system manufactured by KIN TEL consists of a rugged yet sensitive camera that is small enough to hold in your hand; a receiver that displays pictures that are twice as sharp as you can get on your home TV set; and a camera control unit that is so automatic the only control you have to touch is the on-off switch.

More Than Likely, Your Business Can Use Such a System.

You can use one to watch events or operations that are tedious, difficult, dangerous, or even impossible for men to watch.

Dependable KIN TEL TV systems see where men cannot survive; withstand tremendous extremes in temperature and pressure; perform both critical and routine jobs inexpensively, faultlessly, safely, tirelessly.

You can use one for data transmission.



All types of visual information–from blueprints to fingerprints to graphs–are transmitted over great distances quickly, accurately. Such systems save money, reduce errors and confusion, speed operations.

You can use one for surveillance work.

KIN TEL cameras scan vast areas; guard valuable equipment and property; never blink, quit, sleep, or make an error; watch many operations at once; transmit all information to a central monitoring point.

You can use one for on-the-job training.

Students study operations viewed by a KIN TEL camera. Such systems permit mass teaching that gives each student an unobstructed view; provide on-the-spot realism; end expensive, disturbing plant tours.

Here's What a Kin Tel System Can Do for Your Business

It can do what it is doing, right now, for hundreds of other firms. It can increase the over-all efficiency of your entire operation. It can help you tighten production and inventory controls, help you better your services to customers and clients. It can reduce errors and confusion and duplication. It can cut costs. It can save you time and money. It can free valuable men from tedious and routine tasks. It can give you the modern tools you need to keep pace in this highly competitive market.

For a more specific analysis of how KIN TEL TV can go to work for you, write direct for catalog 6-103 and the name of your nearest KIN TEL engineering representative.

8 Reasons Why So Many Firms Insist on Kin Tel TV Systems

1. Reliability. KIN TEL equipment is designed to keep working, day in and day out. It's the first choice for ICBM and other missile programs that depend on TV, that can't afford to compromise with reliability.

2. Picture Quality. Full 650-line resolution provides maximum delineation, essential for qualitative observation of complex operations, and for transmission of printed material.

3. Automatic Operation. KIN TEL TV is the only closed circuit system that provides entirely automatic, through-the-lens compensation for light-level changes of several thousand to one.

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5. Ease of Installation. No site preparation is needed, no interacting electrical adjustments are required. All units fit in standard 19-inch racks.

6. Simplicity of Operation. With no changes in lens iris to make, the only thing the operator has to know is the location of the on-off switch.

7. Adaptability. A complete line of shelf-item system components and a variety of cameras and monitors permit observations of nearly every kind of operation, under all kinds of conditions.

8. Application Help. You don't have to waste your money and time on application engineering. At no obligation, KIN TEL's nationwide factory-trained field engineers will determine whether or not a TV system can be put to profitable use in your intended application.

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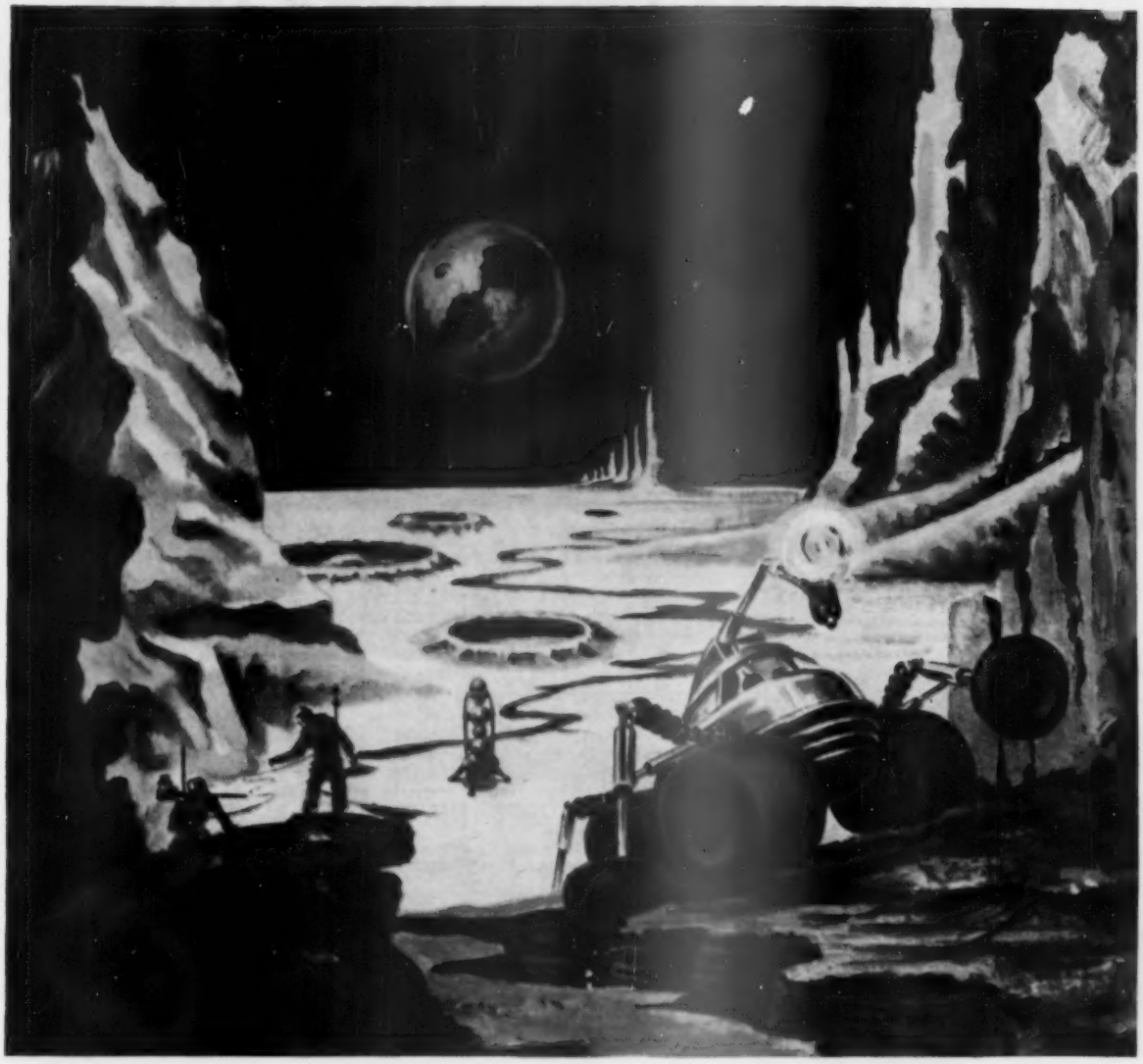
KIN TEL—pioneer and leader in closed circuit television



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	Midvac	117,000 psi	150,500 psi	21.3%	33.8%
D6A-C	Air Melt	234,800	281,000	4.9%	20.6%
	Midvac	256,700	294,250	9.6%	28.4%
Tricent	Air Melt	238,600	284,500	6.1%	19.7%
	Midvac	254,300	291,600	10.3%	25.6%
901 Regular	Midvac	116,000	160,000	18.0%	25.0%
901 Hi-Strength	Midvac	131,000	179,000	19.2%	20.2%

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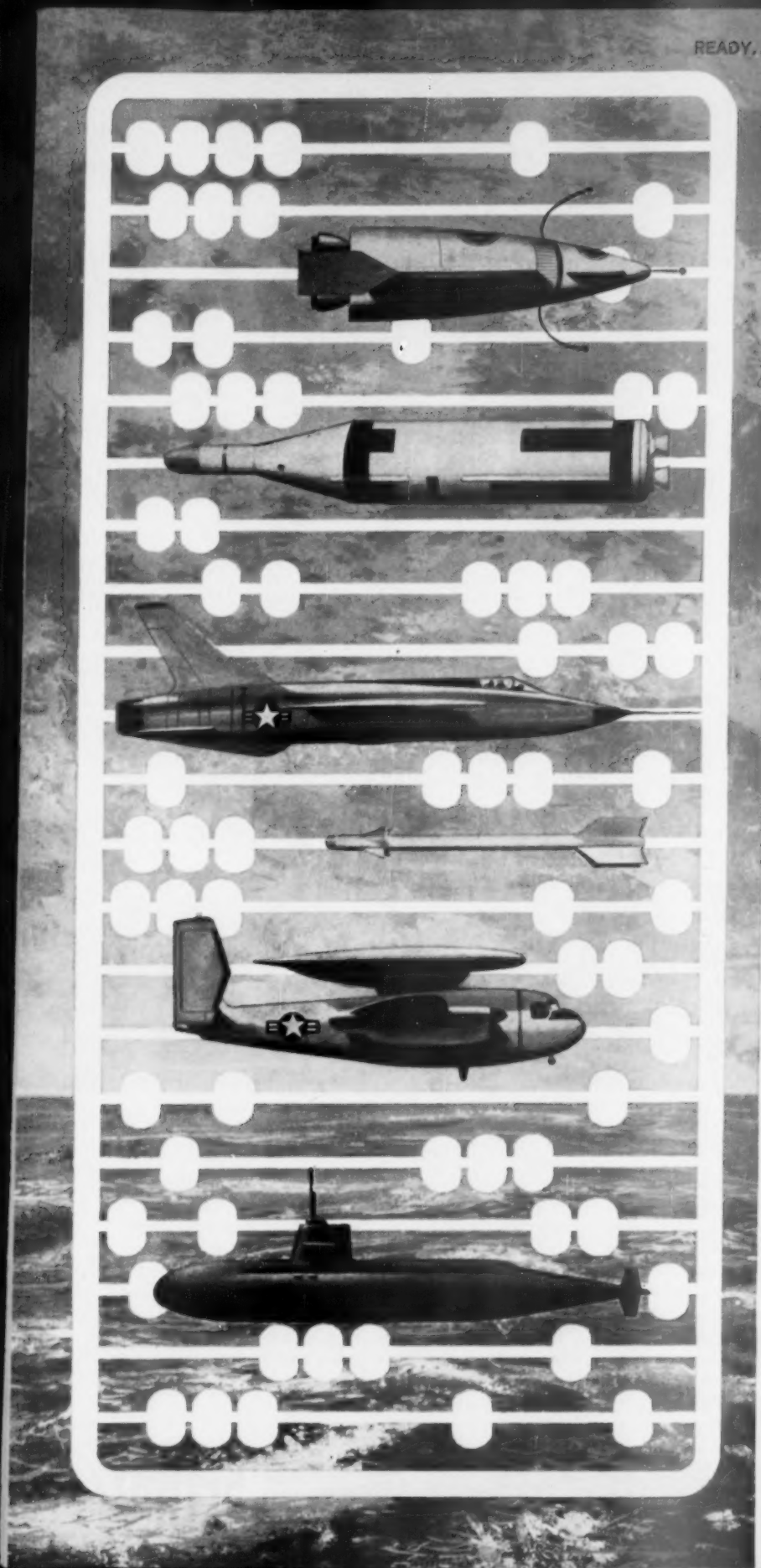

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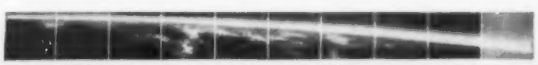

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COVER: Convair Atlas ICBM booster is photographed at about 250-mi. altitude a few seconds after it separated from a camera-equipped RVX-2A re-entry vehicle. The missile is in sunlight but the earth below is not visible because it was in early morning darkness. Flight was conducted on Oct. 13 as part of USAF's Air Research and Development Command's ballistic missile development program. The re-entry vehicle, which was developed and built by General Electric Co., attained a maximum altitude of about 700 mi. and landed 5,000 mi. downrange from Cape Canaveral, Fla., before it was recovered. This black and white photo was made from one of the first color space photos ever taken.

PICTURE CREDITS

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The revolutionary Liquid-cooled brakes developed by B.F.Goodrich have now been engineered for the Boeing 707-720. With completion of flight tests of the brakes on the 707 prototype, kits for equipping airline 707's for service testing and future certification are now being offered.

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EDITORIAL

Supersonic Transport Race

A major program requiring rescue from an interdepartmental government squabble is the effort to develop a supersonic transport. Since President-elect John Kennedy stressed ebbing U.S. prestige abroad so much in his successful campaign against his "all's well in the world" opponents, he should be especially interested in the supersonic transport race, for the progress in successful development of a supersonic transport will be a major index of international technical prestige in the final year of his initial administration. Proof of which country really wins this race will be readily evident to all the world. The winner will simply get the major share of orders for this type transport placed by the international airlines outside the Sino-Soviet bloc.

This is an area in which U.S. prestige is still high. Almost all the turbojet transports in the transatlantic trade today are built in Renton or Long Beach. A similarly high percentage of turbojet transports operated over other international routes by airlines of all flags will be of U.S. manufacture, with the Convair 880 and 600 series joining the Boeing 700 series and the Douglas DC-8s. This unmistakable superiority in the jet age is simply a continuance of the U.S. tradition of transport manufacturing excellence begun in the prewar era of the DC-3 and maintained in the postwar piston decade with Lockheed Constellations, Convairliners and Douglas DC-6s and 7s.

With this long tradition of superiority in the international transport equipment market, it would indeed be a major blow to U.S. prestige abroad if some other flag flew first on a successful, here-to-stay supersonic transport.

Fortunately, there have been Americans with sufficient technical vision to perceive the requirements for supersonic transport development. Lockheed, Boeing, Douglas and Convair have all spent some of their own money and technical resources in exploring this area. General Electric and Pratt & Whitney are developing the economic powerplants for this speed range. In the government, men such as John Stack of the National Aeronautics and Space Administration and E. R. "Pete" Queseda, Federal Aviation Agency administrator, have devoted their efforts to researching the blank spots in this technical spectrum. They have also organized plans for an effective national program to work swiftly and soundly toward bringing the supersonic transport into being as another chapter of U.S. leadership in dependable, economic airliners.

This program developed by FAA proposes to utilize fully the resources of NASA, the Air Force and the leading transport manufacturers in a truly national program. It is obvious from even a preliminary examination of the finances required that they are far beyond the resources of any private corporation. This program is now in the White House on President Eisenhower's desk, where it will no doubt come to the attention of President-elect Kennedy if he looks carefully for it.

However, there are signs that an interdepartmental squabble may scuttle this program during the interregnum before Sen. Kennedy formally assumes executive authority. Chief villains in the piece appear to be the Air Force and its alumni now operating at the Secretary of Defense office level. It would appear from recent comings and goings at the White House that USAF, or at least some of its powerful leaders, would like to keep the supersonic transport project as a strictly military program under its exclusive control.

The excuse for this position is apparently a feeling that the supersonic transport can be readily hatched from the B-70 Mach 3 bomber program now under way at North American Aviation. We can understand USAF sensitivity about anything even remotely impinging on the B-70 program. It has fought a desperate battle to prevent this important weapon system from being killed by financial starvation during the recent budgetary battle.

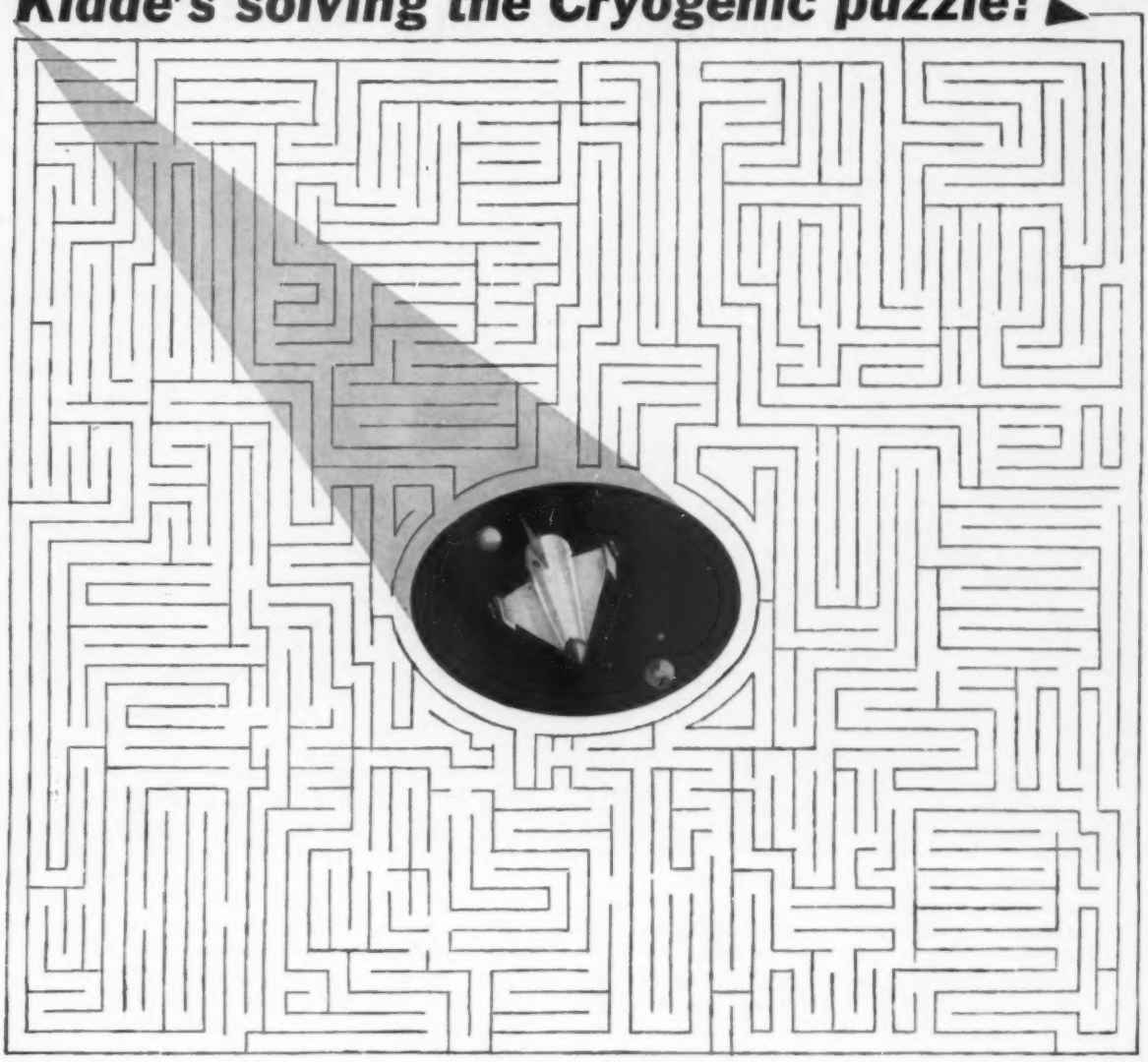
However, we think the Air Force position in attempting to pull a national supersonic transport development program under the B-70 bomber blanket is basically unsound. The B-70 program aims at a major state-of-the-art advance in pushing aeronautical operational ranges beyond Mach 3, the point to which current technology has already carried military aircraft. Technical history of the transport industry indicates that development of a successful commercial transport design always lags a prudent distance behind the most advanced military development to take full advantage of its mistakes and to fully incorporate all of the new knowledge it generates into a dependable and economic machine. For example, 10 years of swept-wing B-47 and B-52 jet experience preceded the Boeing 707's entrance into airline service. It does not seem technically sound to try to bring along a Mach 3 bomber and transport concurrently.

Also, we think it would be a great mistake to make the supersonic transport development program a purely military venture. With all due respects to USAF's technical capability, we do not believe they have the economic perspective to successfully develop a transport that would be operationally attractive to either domestic or foreign airlines. The supersonic transport must be designed and developed with the operating economy of commercial airline requirements clearly paramount from the start or it will be a dismal failure in the international market.

It is already evident that we are in an international technical race to develop the supersonic transport. Britain has designated the British Aircraft Corp. to carry its flag in this race, while the French combine of Sud Aviation and Dassault was organized some time ago to plant the tricolor firmly in this field. Soviet designers and politicians have made it clear that they are also working in this area.

We strongly recommend that the new Administration pick up the supersonic transport ball as quickly as possible. It should have a sound working program ready to present to Congress in January, incorporating both military and civil requirements and drawing on all of the best technical resources available. This program should also be vigorously presented next April to the supersonic transport symposium of the International Air Transport Assn. when the airlines of the world take their first hard look at this subject in Montreal. —Robert Hotz

Kidde's solving the Cryogenic puzzle!



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WHO'S WHERE

In the Front Office

James T. Dresher, vice president-finance, Fairchild Engine & Airplane Corp., Hagerstown, Md. Due to his association with New York Airways, Inc., Grover Loening has resigned as a director of Fairchild, but will continue actively as a consultant to the corporation in the development of VTOL/STOL areas.

San Diego (Calif.) operations of Ryan Aeronautical Co. are now organized as a separate division, the San Diego Division, and **Edward G. Uhl** has been appointed vice president and division manager. Appointed vice presidents on the new staff: **C. A. Stillwagen**, finance; **Frank W. Fink**, engineering; **H. E. Ryker**, manufacturing; **William Wagner**, public and personnel relations.

William H. Bailey, executive vice president, Nuclear Corporation of America, Denville, N. J.

Rear Adm. Otto A. Scherini (USN), ret.), vice president-marketing, Airpax Electronics, Ft. Lauderdale, Fla.

Charles G. Chisholm, vice president-marketing, Haynes Stellite Co., division of Union Carbide Corp., New York, N. Y.

Roy E. Woenne, vice president and technical director, Litton World Trade Corp., with headquarters in Zurich, Switzerland.

Thomas O. Walthall, vice president-administration, Stanley Aviation Corp., Denver, Colo.

Richard N. Bale, executive vice president and sales manager, International Air Service Co., San Francisco, Calif.

L. F. A. Mitchell, vice president-sales, Vitro Engineering Co., a division of Vitro Corporation of America, New York, N. Y.

C. M. Este, division chief, Materiel Program Division, Bureau of Facilities and Materiel, Federal Aviation Agency, Washington, D. C.

Honors and Elections

Dr. Chauncey Starr of North American Aviation, Inc., has been elected an Eminent Member of Eta Kappa Nu, national electrical engineering honor society, in recognition of his outstanding leadership in the electrical engineering field.

Changes

Dr. Charles F. Squire, divisional director of research and head of the newly formed scientific laboratory of Hamilton Standard Division of United Aircraft Corp., Windsor Locks, Conn.

George L. Downs, manager-Minuteman program office (AW Oct. 3, p. 38), Amherst Laboratories of Sylvania Electric Products, Inc., Buffalo, N. Y., and **Robert D. Gray**, technical program manager.

Robert H. Hemmig, special assistant to the director, Office of Technical Information and Education, National Aeronautics and Space Administration, Washington.

Philip Bono, design specialist, missiles and space systems engineering, Advanced Design Section, Douglas Aircraft Co., Inc., Santa Monica, Calif.

(*Continued on page 149*)

INDUSTRY OBSERVER

► Convair-Avco team will propose a multi-man Apollo vehicle shaped as an axially symmetrical lifting body with no appreciable wing surface. No propulsion will be used during the vehicle's re-entry maneuver, and landing will be planned for a dry lake near Edwards AFB, Calif. Teams led by Convair, General Electric and Martin are conducting Apollo feasibility studies for NASA.

► **Air Force is expected to award a $15-25 million contract for the Dyna-Soar communications-data link subsystem by mid-December. Representatives of Boeing, the vehicle assembly and test contractor, were called to Wright Air Development Division last week to hear a report on a recently completed WADD evaluation of 10 proposals which were requested from Bendix, Collins Radio, GE, IBM, Litton, Motorola, Packard Bell, Philco, RCA and Western Electric. Weapon System Project Office is evaluating inertial guidance proposals from 12 companies, and a decision is expected early next year.**

► French air force is asking bids for a light STOL transport capable of flying 950 mi. at 220 mph. with a 3,000 lb. payload. There is $36 million earmarked for the project in the five-year military program. Bidders include Dassault, Breguet and Max Holste.

► **Bids for automatic programing and test system (APATS) for Lockheed's Hivos (high-vacuum orbital simulator) are due today. APATS, estimated to cost $1.2 to $1.5 million, is the satellite control and readout element of the Hivos space environment simulator. Bidders include Avien, Electronic Engineering Co. of Calif., Electro-Instruments, Bendix Eclipse-Pioneer Division, Nortronics, Otis Elevator, Packard Bell, Radiation, Inc., RCA and Temco.**

► North American Aviation is studying variations of laminar flow control for application to the Mach 2.5-3 transport which could logically stem from the B-70 Mach 3 bomber development program.

► **Proposals for an electronically controlled precision photographic mapping system, to be used by aircraft at altitudes below 35,000 ft., will be requested soon by WADD. An integrated geodetic and cartographic system, it will be required to have better accuracy than currently available systems and to reduce actual line measurement time 40%. Bidders are expected to include such firms as RCA, Lockheed, Convair, Seiscor, Motorola, Fairchild Camera and Instrument and Chicago Aerial Industries.**

► One top contender in the Project Saint satellite payload competition i RCA's Astro-Electronics Division. Ballistic Missile Division received proposals from about a dozen companies to develop the payload for the rendezvous/interceptor vehicle.

New Navy anti-submarine project, PUFS (Proposed Underwater Fire-Control Feasibility Study), is based on a highly advanced, wide-range sonar. It is still a study, but Electric Boat Co. and several other companies are developing hardware and some sea trials have been made. System is to be installed on present and future submarines.

► Bidding specifications for the tri-service VTOL transport prototype will be broad enough to permit proposals for any type aircraft in this category. Joint service program will produce 5-6 prototypes for operational testing. Transport will lift 4 tons, fly at 250-300 kt. over a 1,500-2,000 mi. range.

► **Ishikawajima Heavy Industries, Ltd., has a license agreement to produce the General Electric T58-8 turboshaft helicopter engine and its CT58-110 commercial version, but the Japanese and U. S. governments still have to approve the deal. Japanese company also is licensed to produce GE J79 tubojet engines.**

► Soviet Academy of Sciences has established the Shemakha Astrophysical Observatory in eastern Azerbaydzhan, near the Caspian Sea.

HAYNES ALLOYS

RESEARCH REPORTS

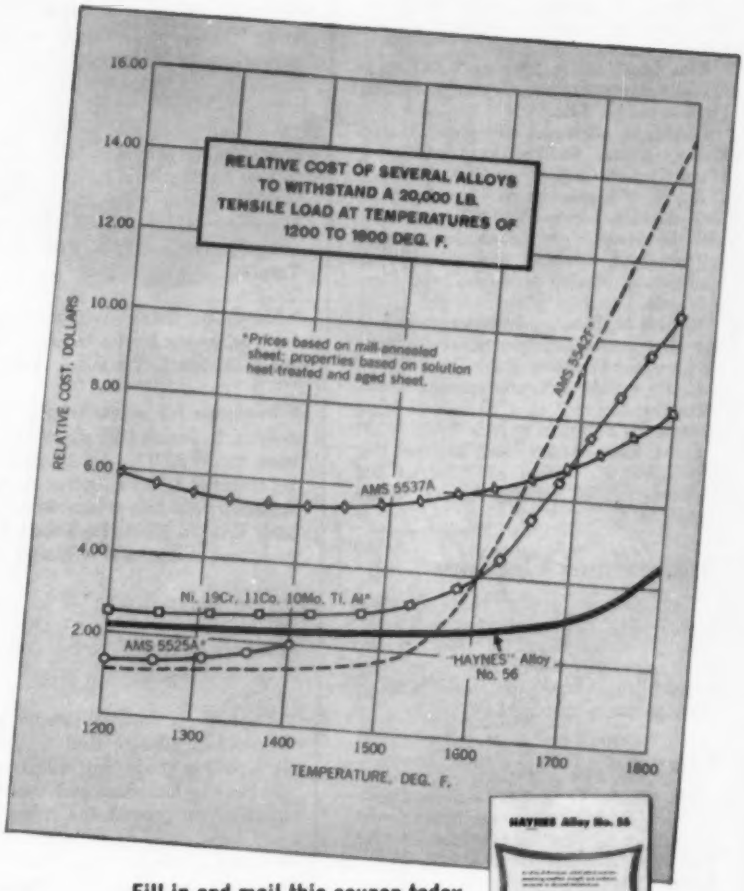
New High-Temperature Alloy Improves Cost-To-Strength Ratio

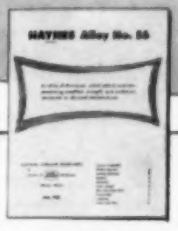
Excellent strength and oxidation resistance in the 1200 to 2000 deg. F. range are among the features of HAYNES Alloy No. 56—a new high-temperature alloy developed by Haynes Stellite Company.

A sampling of its cost advantages at a given tensile load, compared with other high-temperature alloys in the graph at the right, is well worth your study.

Alloy No. 56 can be readily hot-worked and formed. It is easy to heat treat. It comes in the form of sheet, plate, bar, wire, and coated welding electrodes, and can be furnished as sand-, investment-, and resin shell-mold castings. The coupon below will bring you a wealth of technical data.

The new iron-base alloy contains nickel, cobalt, chromium, and molybdenum. It has high strength at temperatures up to 1500 deg. F and maintains useful strength at temperatures as high as 2000 deg. F.





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Washington Roundup

Congress Plans Probes

Watch for an unusually comprehensive investigation of the nation's space programs next January by the House Science and Astronautics Committee. This committee was criticized last year for its internal feuding and sometimes haphazard hearings.

But the new hearings have been skillfully planned to look deeply into a broad variety of subjects. The committee is expected to reach down as far as the chief engineer level in calling industry witnesses for expert testimony.

Industry and the military services also may be in for a round of investigations on old, familiar issues. Procurement costs, which Congress has become increasingly tougher about, head the list. In 1958, Congress admonished the services for loose contracting procedures. Last year, it voted a one half per cent cut across the board in procurement items, and this year it cut all Fiscal 1961 procurement by 3%. It has warned that it will cut once more unless it is satisfied by the corrective measures taken in the meantime.

Air Force has now gone beyond its repeated requests to industry to tighten up and has begun surveys of specific companies to see whether present management techniques can keep pace with modern weapon technology. First on the list is Martin Co.'s Titan program. USAF's Inspector General will head the survey team.

Renegotiation, conflict of interest, tax depreciation, indemnification of missile launching contractors, incentive and negotiated contracts, and subcontracting to small business are all in for reviews of varying degrees of intensity.

Electra Investigation

Hearings on the Electra crash at Boston will be held this week by the Transportation and Aeronautics Subcommittee of House Interstate and Foreign Commerce Committee, followed by a look at the aircraft's airworthiness.

Next month, the same committee will look into the Federal Aviation Agency. Rep. John Bell Williams, the chairman, will investigate the way the FAA act is being administered, whether FAA is following the law or intent of Congress, and how the agency makes and enforces its rules. He also intends to go over airline maintenance procedures. Tentative date for the hearings is Dec. 14, 15 and 16.

The specter of former Defense Secretary Charles E. Wilson still haunts the Army, even though the Eisenhower Administration is about to leave office. Four years ago next week, Wilson issued a memorandum limiting the size, weight and range of Army missiles and aircraft.

This famous memo started the Jupiter-Thor intermediate range missile war within the Pentagon walls, and it still serves as a psychological barrier to the Army and its development contractors. Exceptions to the memo have been made in specific cases, but Richard Morse, Army's research and development chief, considers its very existence a "stifling" influence. He has asked Defense's office of Research and Engineering to rescind it.

Keith Glennan definitely will not remain as National Aeronautics and Space Administration administrator under the Kennedy Administration. He is telling friends that he will be taking a well-earned vacation in Europe about February, before returning to Cleveland. He has been on leave from the presidency of Case Institute of Technology.

USAF Budget Plans

USAF does not plan to develop a tactical range missile or a long range interceptor unless the largest of the four budgets it submitted is approved. This one calls for a Fiscal 1962 spending level 10% above the current budget. Air Force also has no money earmarked for the Convair B-58 bomber in its new budget.

Russian publicists don't agree with Air Transport Assn. President Stuart Tipton's opinion that Aeroflot made a mistake in concentrating so heavily on turboprop transports instead of turbojets, which the public seems to prefer.

A new Soviet brochure entitled "Aviation in the National Economy" says that the Il-18 and An-10 turboprops have better takeoff and landing characteristics, use two to two-and-a-half times less fuel, don't require construction of long concrete runways, are simpler to operate and have considerably lower ton-mile costs than turbojets. Later in the 1959-1965 seven year plan, Aeroflot plans to increase the use of straight jets.

—Washington Staff.

USAF Launches Anti-Satellite Program

Saint to begin with three-year demonstration phase; $60 million project calls for four test interceptions.

Washington—Defensive program to pit satellites with interception, inspection and kill capabilities against unidentified, potentially hostile satellites is being initiated by the Air Force under Project Saint, climaxing three years of planning and preliminary studies.

A three-year demonstration phase—costing some $60 million and calling for the launching of four target satellites and four interceptor satellites—will begin immediately after the final selection of contractors late this year.

Soviet Union has been considering similar systems, and some U.S. scientists believe Russia will have an anti-satellite capability by 1963.

If the feasibility of Saint—for satellite intercept—is proved by the demonstration phase, a highly accelerated development program for an operational system is expected to follow.

Twenty-seven firms attended briefings early in September on the interceptor satellite and payload (see box). Selection of prime contractors for these two tasks was expected by mid-November, with approval of this selection from top Air Force and Defense Department echelons expected by mid-December.

Saint Launching Vehicle

Launching vehicle for the demonstration satellites will be the Convair Atlas topped by the Lockheed-Bell Agena B stage. Saint will be essentially a third stage consisting of the final stage propulsion vehicle plus an integral payload for controlling orbit and inspecting the target satellite.

Later operational versions would also include a kill capability because it is assumed that enemy satellites may some day carry weapons that could be aimed at targets on earth or at other missile and space systems in flight.

Launching vehicle for the four target satellites may be the same as for the Saints or it might be the lighter Thor-Able Star, which has been used to put Transit and Courier satellites into orbit.

A tight schedule laid down under present plans calls for launchings of the demonstrator satellites beginning about the end of 1962 and covering a period of five or six months.

Both targets and demonstrators probably will be launched southeast from Cape Canaveral, Fla., into 400 naut. mi. orbits, following the same general trajectory as that planned for the Transit IIIA navigation satellite (AW Nov. 7, p. 57).

Demonstrator satellites probably will be designed to function only from 2 to 48 hr. in orbit because of the elementary nature of the data required to prove feasibility. This would require only a limited power supply, eliminating the need for solar cell panels or long-life energy storage capability and making nickel-cadmium batteries adequate for the job.

Power Requirements

Probably no more than ¾ to 1 kw. of power would be required for the satellite during the boost phase for all power functions. Peak load during the orbital period should be no more than about 150 watts.

The Agena B stage would place Saint into an orbital path near enough to that of the target satellite for refined maneuvers to begin. Saint then would use its final propulsion stage to maneuver close enough for inspection.

Maneuverability of the final stage will be one of the most difficult and important aspects of the project. The stage will require restartable rocket engines for longitudinal and transverse thrust, and attitude control jets. Only a relatively small amount of maneuvering thrust should be required.

A direct intercept technique probably will be used. With this technique, the target satellite would be allowed to make one pass while ground stations gained orbital data for computing what trajectory is required to launch Saint into an intercept orbit on the target's second pass.

Saint probably will be launched slightly above and ahead of the target satellite, rather than into an orbit behind the target. Traveling at a faster speed than the target, Saint would scan, acquire and then slow its velocity with retrorockets to decay its orbit and bring it into reasonable proximity with the target.

Parking Orbit

Technique of retaining the Saint demonstrator in a "parking" orbit and releasing it later to co-orbit with the target is not likely to be adopted because of the auxiliary power supply requirements involved during the extended parking period.

If the Saint concept evolves into a technique of using one satellite to intercept and inspect the target and a separate satellite to carry the kill mechanism, the parking orbit might be used for the weapon satellite.

Saint demonstrators probably will carry only a television camera and a radar for inspection, since the experiments will be programed only to prove that the basic concept is feasible. This might be the first use of radar in a satellite.

Initial lock-on distance requirement may not exceed 50 mi.—an indication of how precise the parameters may be for the initial separation distance between Saint and the target. Inspection, however, might require the Saint to approach the target as closely as 50 to 100 ft.

Operational Saint payloads probably would include radar, TV, infrared equipment, electronic countermeasures and radiation sensors to determine if the target contained a nuclear weapon.

Inspection requirement for operational satellites also would involve the ability to distinguish between armed

Saint Bidders

Washington—Twenty-seven firms attended Air Force Ballistic Missile Division briefings on the Project Saint interceptor satellite vehicle and its payload early in September. They were given some 45 days to submit proposals.

Because of the close interrelationship of vehicle and payload, some companies will bid as teams. Eight firms attended both briefings, and some or all of these may bid for both parts of the job.

Those attending both briefings were Bendix, General Electric, Hughes, Lockheed, Northrop, Radio Corp. of American, Raytheon and Western Electric.

Attending the briefing for the final stage vehicle only were Bell Aerosystems, Boeing, Convair, Douglas, Martin, Minneapolis-Honeywell, North American, Sperry Rand and Thompson Ramo Wooldridge.

Companies attending the payload briefing only were Airborne Instruments Laboratory Division of Cutler-Hammer; Avco, Columbia Broadcasting, General Precision, International Business Machines, International Telephone & Telegraph, Litton, Philco, Sylvania and Westinghouse.

Defense Department's Advanced Research Projects Agency has general cognizance of the program. BMD has executive responsibility. Aerospace Corp. has technical responsibility and co-management with BMD. Saint will be Aerospace's first major program.

satellites and hollow, balloon-like decoys. One method of determining mass of the target in order to estimate its equipment weight might be to require the inspecting satellite to move close to the target and then fire retrorockets against it, gaging mass from the target's relative rate of acceleration.

Use of inoperative scientific satellites already in orbit as targets is not expected in the Saint demonstrations unless the orbital characteristics of the dead satellite happen to conform to requirements of the experiment.

Use of a "piggyback" target satellite, launched with Saint and separated from it in orbit, also is considered unlikely because the orbits would be so close initially that the experiment would be unrealistic.

Saint concept originally was incorporated in a General Operational Requirement. It evolved into a Systems Development Requirement in 1957. Funded studies were issued under Study Requirement 187 in 1958 and were carried on last year by Space Technology Laboratories and Radio Corp. of America.

Development plans were not firm until the middle of 1959. Review and updating occurred early this year and again in mid-year. This last evaluation of the development plan forms the basis for the existing industry competition.

Army Mounts Major Budget Fight For Acceleration of Zeus Project

Washington—Army has mounted a major effort to push its Fiscal 1962 budget request for nearly half a billion dollars to accelerate the Nike Zeus anti-ICBM program, basing its campaign on development progress and new technical advances.

The campaign faces heavy opposition from proponents of more advanced defense concepts, such as Air Force's Bambi system, which is in the planning stage and is designed to counter the ballistic missile threat (AW Oct. 31, p. 33). USAF argues that such satellite systems would offer more effective defense than Zeus.

Army counters that any system involving orbiting satellites could not be operational before 1975 and therefore couldn't compete in terms of the Zeus schedule. Army says its anti-ICBM program has progressed so rapidly in the past six months that the weapon system could well be ready before bases and personnel are prepared to handle it.

Army Campaign

Army's campaign for sharply increased Zeus funds calls for a decision to launch a full-scale production program, which would commit the Defense Department to spending an estimated $5-15 billion over the next nine years. Army estimates the cost at $7 billion, but whatever the amount, the request will run into heavy opposition from the other services competing for defense funds.

Army has named a new study committee to help in its fight for Zeus production funds. This group, which includes Defense Department and White House representatives, is to survey the Zeus program and decide whether it is far enough along to warrant committing a large budget for production and site acquisition. Army is confident this committee will make a report favorable enough to provide strong support in the budget struggle.

Organization of the committee was suggested by Richard S. Morse, Army director of research and development, and he is chairman. The group was meeting last week to study the Zeus program, and an early decision is expected since the preparation of the Fiscal 1962 budget is already well along.

The unusual step of inviting Defense and White House representatives to join the Army study committee is an attempt to enlist outside support from offices which have blocked a bigger Zeus budget in the past. Dr. J. P. Ruina, assistant director of defense research and engineering (air defense), and Hector Skifter, air defense aide to Dr. George Kistiakowsky, White House scientific adviser, are serving on the committee with Brig. Gen. L. J. Lincoln, director of plans and materiel, office of the deputy chief of staff (logistics); Brig. Gen. J. T. Snodgrass, director, air defense and special weapons, office of the deputy chief of staff (operations), and Brig. Gen. D. C. Lewis, director of special weapons, office of the chief of research and development.

Army has support in Congress from Rep. Overton Brooks, chairman of the House Committee on Science and Astronautics, who called for accelerating the program by release to the Army of all or part of the $130 million still available to the Department of Defense from extra Fiscal 1961 funds voted by Congress for over-all defense research and development.

Urging acceleration of the Zeus program, the Army backs its arguments with claims of a breakthrough in the system's ability to discriminate between decoys and warheads and claims of greatly increased missile speed through development of more powerful boosters. This greater speed would permit warhead interception farther from the warhead's intended target.

Air Force argues that the Zeus system has to wait too long before intercepting a warhead. It maintains that waiting until a missile warhead has had time to separate into multiple warheads or to deploy decoys during the coasting and re-entry phases multiplies the threat and raises the cost of defending against it. Air Force approach is to intercept the missile in its powered flight phase.

Control Center Role

Under Army plans, Zeus control centers are to be scattered across the country, with each center controlling a number of missile batteries. Each center will be equipped with an acquisition radar to spot incoming targets and give the signal to tracking radars to plot the trajectory.

The acquisition radar uses separate transmitting and receiving antennas. The transmitting antenna consists of three arrays placed in a horizontal, triangular pattern which can rotate horizontally in a full circle. The receiving arrangement consists of a Luneberg lens, which is a three dimensional, varying dielectric constant material antenna with the ability to focus a returning echo picked up by receiving horns which rotate synchronously with the transmitting antenna.

The acquisition radar, combined with computers and tactical control and monitoring equipment, will be able to provide track information on a large number of incoming vehicles. Although most of the operation will be automatic, both scope and panel displays will permit human judgment to be exercised.

A typical weapons battery will be equipped with high precision target track radars for end-of-trajectory guidance, separate discrimination radars, a missile track radar to guide the defensive missile to intercept, a computer which processes data and issues launch and guidance commands to the missile, and the Nike Zeus anti-missile missiles themselves.

Zeus Configuration

The 50-ft. Nike Zeus missile will have three stages, all solid propellant. The first stage has four fixed fins with swept leading edges and flat tips. Second stage has four fixed delta fins, and the third stage has four controllable delta fins.

First stage, powered by a Thiokol motor, furnishes 500,000 lb. of thrust. Second and third stages have Grand Central motors. The third stage is smoothly tapered from a sharp nose. Second stage has a slightly larger diameter and there is a smooth fairing between stages. First stage diameter is

First Flight Photo of Initial German F-104G

First flight photo of initial Lockheed F-104G Super Starfighter produced for West German air force shows aircraft undergoing flight testing at Lockheed's Palmdale, Calif., facility. Germany is receiving quantities of two-place F-104Fs and the single-seat F-104Gs from Lockheed's production line. Subsequent production will come from manufacturing program linking Lockheed with manufacturers in Germany, Belgium and The Netherlands.

considerably larger than the second stage, and there is a more sharply angled fairing between stages.

Test program for Nike Zeus involves the use of all three major U.S. missile ranges. In the Atlantic Missile Range, Zeus acquisition and other types of radars have been installed at Ascension Island in the South Atlantic where advantage can be taken of flights of Atlas and Titan ICBM nose cones. Data has been obtained on trajectories, decoy characteristics and atmospheric boundary layer reaction on radar returns.

In the same area, another project, called DAMP for downrange anti-missile measurement program, is being conducted by the Army Rocket and Guided Missile Agency for the Department of Defense's Advanced Research Projects Agency. A U.S. Army ship, the American Mariner, in operation since February, 1959, is an ocean-going scientific station which carries precision equipment for making optical, electronic and infrared measurements during the terminal phases of missile firings.

Data obtained from DAMP and Ascension Island will be used in test programs at the White Sands Missile Range and the Pacific Missile Range.

At White Sands, a facility to launch test targets has been constructed near the northern boundary of the range. It is called ZURF, for Zeus Up-Range Facility. Radar missile and guidance development tests will be performed by Bell Telephone Laboratories and Douglas Aircraft Co. All types of radar used in the system will be installed, along with prototype tactical launch cells and support facilities.

Zeus has been fired successfully from underground cells at White Sands at short range ballistic missile targets. The targets have been the Nike Hercules, and Speedball and Highball missiles developed by New Mexico State University.

The Pacific Missile Range will provide facilities for testing Zeus against ICBMs. Launching installation will be at Pt. Mugu, Calif., for extension of Zeus vehicle flight tests not possible at White Sands. Zeus will be fired from Kwajalein Atoll in the Marshall Islands against ballistic targets—Atlas missiles fired from Vandenberg AFB.

In testing at Kwajalein, any deficiencies discovered will be retested at White Sands and Pt. Mugu before being tested further at the Pacific atoll.

Construction is under way on the islands of Kwajalein, Gugeegue, Ennylabegan and Roi-Namur. Zeus system and some of the optical instrumentation will be located on Kwajalein. Telemetry and communications receiving stations will be on Ennylabegan, and transmitting facilities will be located on Gugeegue. Launching site for Speedball targets will be Roi-Namur.

In addition to Atlas targets, Speedball and a B-47 aircraft will be used in checking out the system before it is fired against an ICBM.

To obtain background data for operation of the detection systems, Project Press, for Pacific Range Electromagnetic Signature Study, has been conducted at Kwajalein. Press is a step beyond the acquisition, identification and discrimination abilities of the Zeus system. It aims at detection at an earlier stage—in the pre-re-entry or coasting phase. Missile warheads and other vehicles produce individual characteristics in their returns which in later versions of the Zeus system may be added to computer data.

In further support of the development program, two advanced radars will be installed on Roi-Namur. Both will be supported by high altitude aircraft carrying infrared instrumentation. One radar will be Tradex, similar to BMEWS radars. It is under development by Radio Corporation of America.

Tradex will be used for mid-course and re-entry phases of missile flight. Pincushion radar, produced by Raytheon Corp., will perform the same function but will operate on a different frequency and will use a different system of data collection.

System manager for Nike Zeus is the Army Ordnance Missile Command, while Army Rocket and Guided Missile Agency is the system technical supervisor. Prime contractor is Western Electric, with Bell Laboratories and Douglas Aircraft as major associate contractors.

Command Unit Failure

Washington—Failure of the Army Courier communications satellite after 18 days in orbit is believed due to a malfunction in the satellite's command decoder unit, which is supposed to turn on the transmitters when it receives the proper command from a ground station. Fault may have occurred in the switching unit which alternately turns the two command receivers on and off, with a nine-second off period intended to conserve battery power. Satellite's VHF tracking beacon transmitter is still operating.

During 18 days of operation, Courier broadcast for a total of approximately 35 hr., relaying an over-all total of 118 million teletype words. Reliability prediction curves prepared by Arinc Research Corp. (AW May 23, p. 75), although not intended specifically for application to Courier payload which employed considerable redundancy for added reliability, indicate a time-to-failure of 35 to 100 hr. for a system of Courier's complexity.

Satellites Planned to Detect Space Blasts

By Larry Booda

Washington–Operational satellite system designed to detect nuclear explosions in space is being developed under Defense Department's Project Vela Hotel. The program calls for six satellites orbiting at 60,000 naut. mi. from earth by late 1962.

Earlier steps in this phase of the over-all nuclear explosion monitoring program call for the launching of 25-lb. "piggyback" instrument packages as part of USAF Blue Scout space probe payloads and flight of similar packages in Atlas, Titan and Minuteman missile nose cones.

As the full scale program gets under way, experimental satellites will be launched into highly elliptical orbits. The operational satellites will follow, being launched into circular orbits to provide continuous coverage.

Project Vela was undertaken by Defense's Advanced Research Projects Agency in September, 1959. In collaboration with the Air Force, Atomic Energy Commission, the National Aeronautics and Space Administration and Departments of Commerce and Interior, ARPA initiated a research and development program designed to increase understanding of the complex technical problems connected with detection of nuclear explosions generally, and particularly during the moratorium on nuclear tests.

With universities and other private organizations participating, Vela was subdivided into:

- **Vela Uniform**–research and development concerned with the detection of underground nuclear explosions.
- **Vela Sierra**–research and development concerned with ground based detection of nuclear tests in space.
- **Vela Hotel**–ARPA order 102-60 established the working group for Vela Hotel, including USAF Air Research and Development Command, AEC and NASA.

Space Flight Program

The 25-lb. instrument packages for rocket flights will carry scintillators and other radiation detection devices to cover the spectrum of nuclear explosions. During the low trajectory phase of the experiments aboard ICBMs, the mean high altitude will be 500 naut. mi. Six ICBM piggyback rides are now planned.

Blue Scout flights will be above 1,000 naut. mi. and will extend to as high as 30,000 naut. mi. About 14 such experiments are planned.

As the small packages are being sent aloft in the 1960-1963 time period, experimental satellites weighing 278 lb. will be put into orbit. These full-scale satellites will be boosted by the Atlas D first stage and Agena B second stage. This phase will include putting three experimental vehicles into orbits whose apogees will be 90,000 naut. mi. and perigees 350 naut. mi. Each will differ, and each will have two backups in case of failure. Through telemetry readout these satellites will provide an accurate signature of the radiation found between the apogee and perigee for application to the operational phase.

Operational system scheduled for late 1962 or early 1963, envisions putting up six satellites. Three would orbit in one plane and three others in a plane at 90 deg. to the first.

An altitude of 60,000 naut. mi. was chosen for the operational phase due to the low radiation background. By having continuous coverage, it is expected to have a relatively high degree of accuracy for detection of the microsecond duration of a nuclear explosion in near space–that is, within the moon's orbit–and a gradually reducing accuracy out to 1 million mi. from earth.

It is expected that nuclear explosion radiation measurement will be included in future deep space probes such as NASA's Pioneer series, Mariner and Voyager, all of which will be launched with sufficient velocity to escape the earth's gravitational pull.

Defense has made no mention of detection of tests within the atmosphere in connection with Vela. It is known, however, that a large network of sensing stations utilizing a variety of means of detection are scattered over the world, while many types of airborne sensing devices are carried by balloons, rockets and aircraft. The U-2 reconnaissance aircraft carried a "sniffer" for such detection. Little has been said, also, of Project Vela Sierra, which is ground based detection of space nuclear explosions. Among the techniques being investigated are electromagnetic and optical.

Seismic detection under Vela Uniform, however, has been well documented and most fully developed. Technical management of the effort is under the Air Force Technical Applications Center.

Eventual aim is to have a worldwide seismic detection network, with each one using standard, calibrated instruments. This network would provide information beyond that of detection of nuclear explosions and would improve the whole science of seismology.

Two prototype stations are being constructed, one at Ft. Sill, Okla. (AW Oct. 17, p. 25), and the other at Geneva, Switzerland.

Seismologists have participated in recording seismic explosions since the first one, Trinity, at Alamogordo, N. M., on July 16, 1945. The first explosion to provide substantial information because exact time and place were made public was Bikini Baker, an underwater explosion of July 24, 1946. This shot resulted in downward revision of the earthquake energy scale.

The Ranger series of air bursts at AEC's Nevada Test Site in 1951 gave information on crustal thickness. With the Castle series of hydrogen bomb tests in 1954, world-wide recordings revealed the necessity for revision of wave travel timetables from surface epicenters in the Pacific. Stations in Australia detected difference in arrival times which led to identification of the way in which one type of wave was diffracted by the inner core, and as such formed the final link in the chain of evidence for existence of the earth's inner core.

Declassify Data

As time went on the AEC started to declassify explosion data, aiding stations in their routine earthquake watches.

With the first four atomic tests in Australia by the British government in 1956, seismologists for the first time received information as to the continental substructure of that almost earthquake-free area.

As a base for detection of underground tests–the Rainier underground explosion and the Hardtack II series at the Nevada Test Site–studies by Dr. Carl Romney on amplitude and travel time have become the standard text.

Up to September of 1959 about 300 atomic tests had been conducted by the United States, Russia and Great Britain. Of these, the U. S. has revealed data on 169 shots. This data, compared with seismological records, revealed that a deep underwater explosion couples about 1,000 times more energy to the seismic body wave field than does an air burst of the same yield, 400 times as much as a surface burst, and 40 times as much as the underground shots at the Nevada Test Site.

In diplomatic negotiations between the U. S., the United Kingdom and the USSR, as of last week, no definitive agreement had been reached concerning a control system to detect underground explosions of seismic magnitude 4.75 or less and inspection procedures for pinpointing the nature of unidentifiable seismic disturbances within the USSR.

Sharp Defense, Space Changes Expected

Washington—Sharp changes in the way the defense effort will be organized and supported were foreshadowed last week by the election of Sen. John F. Kennedy. National space policy also faces an overhauling by the new President.

Sen. Kennedy has long had advisory groups studying the various problems the Democratic President will face and how they should be solved. He is expected to act quickly in announcing new programs and who will run them in a period of transition that includes these ingredients:

• **Budget changes.** Kennedy will have to move fast to get his own staff in on preparation of the Fiscal 1962 budget, which is well advanced. Decisions on supplemental appropriations for Fiscal 1961 will have to be dovetailed with changes in the next budget to produce the acceleration in defense programs that the Democrats have promised.

• **Defense reorganization.** Kennedy has promised more efficient defense management, and he has predicted that he can pay for part of the increased military effort by eliminating waste. Sen. Stuart Symington (D-Mo.) is to have a defense reorganization plan ready before the end of the year.

• **Space policy.** There is a struggle brewing between National Aeronautics and Space Administration and the Air Force over space roles and missions, and Kennedy will be under pressure to forge a new national space policy early in the coming year.

• **Sen. Lyndon Johnson's role.** With his background in military and space matters, Johnson is likely to be extremely influential in these areas as Vice President in the new Administration. His departure from the Senate also will trigger a number of important changes in space and military committee roles.

• **Problems of transition.** Clark Clifford, a former aide to President Harry Truman, has been preparing plans for a Kennedy takeover, but the President-elect will have to name his top officials in defense, space, budget and other areas soon so they can spend some time learning their jobs before they officially assume them on Jan. 20.

Preparation of the Fiscal 1962 budget is well along now, and Kennedy will be monitoring the process closely to see what the Eisenhower Administration's last defense budget will be like. Thus, he can plan in advance the changes he wants to make after President Eisenhower submits the budget shortly before the inauguration. The sooner Kennedy can get his changes to the Democratic-controlled Congress, the better chance he has of getting the program he wants.

To accelerate some military programs immediately, Kennedy probably will submit a supplemental Fiscal 1961 appropriation request early next year. Some money still may be left from the extra funds Congress voted last summer, and the new Administration won't have time to spend a lot of money between late January and the end of Fiscal 1961 in June. But some kind of supplemental appropriation is sure to be requested, if only to dramatize the new urgency Kennedy says he will infuse into the defense effort.

There is enough money available now to accelerate the B-70 program as much as will be practical next spring, but Congress may be asked for more money to prepare for a bigger, constant B-52 airborne alert, and for missile base construction, Army modernization, Navy shipbuilding and anti-submarine warfare.

For Fiscal 1962, the services have been asked to submit four budget versions, with the most optimistic version calling for a 10% increase in funds. President Eisenhower is not likely to accede to service proposals which would produce a marked increase in defense spending, but these various budget proposals will furnish Kennedy's budget staff with some guides for the changes it wants to make next spring.

Advice on Policy

Sen. Kennedy has had a number of advisory groups at work for several months, including one committee that is preparing a plan of action in the field of national security so the new President will be ready to make the most of the months immediately after his inauguration.

This group includes Roswell L. Gilpatric, Aerospace Corp. board chairman; Paul H. Nitze, president of the Foreign Service Educational Foundation; David K. E. Bruce, former ambassador to France and Germany, and James A. Perkins, Carnegie Corp. vice president and a member of the Gaither Committee. All are prospective members of the new Administration, particularly in such cabinet posts as Defense Secretary and Secretary of State.

Sen. Henry Jackson (D.-Wash.), currently Democratic National Committee chairman, conducted a study early this year on U. S. policy-making machinery. His Senate subcommittee will begin reporting this month.

The Jackson report is likely to recommend such moves as shifting decision-making power away from the White House staff, where President Eisenhower has tended to concentrate it, and back to the department chiefs, such as the Secretary of Defense, acting with the President's over-all approval. Limits on the authority of the Budget Bureau, especially on its power to alter policy as it regulates spending to execute established policy, is another likely recommendation.

This group also will call for closer integration of foreign policy, defense policy and science and technology. It also is likely to recommend measures for recruiting and keeping top administrators in such jobs as defense and service secretaries. This would include modification of conflict-of-interest laws and increases in federal executive pay.

Defense Reorganization

For more specific changes, the Symington group is producing a report on how the Defense Department should be reorganized. This probably will call for reshuffling of the services along functional lines. They would retain their separate identities, but they would be integrated into such joint commands as Strategic Air Command, Continental Defense Command, Materiel Command and Research and Development Command. Sen. Symington personally favors a high degree of centralization, with a single defense chief of staff. There is some doubt that Kennedy will go that far.

Whatever the table of organization, the new Defense Department will require a whole new crew of top executives. One prospect for the Defense Secretary's post is Dan Kimball, president of Aerojet-General and Navy Secretary under Truman. Another is Frank Pace, General Dynamics board chairman and a Truman Secretary of the Army. Symington also has been considered a candidate, but he has clearly stated his preference for staying in the Senate.

Gardner Mentioned

Trevor Gardner, who resigned as assistant Air Force secretary for research and development in protest against Eisenhower policies, has been mentioned for the job of director of defense research and engineering. Gardner is president of Hycon Manufacturing Co. and an Aerospace Corp. board member.

A top contender for the post of scientific adviser to the Democratic president is Dr. Jerome B. Wiesner. He has been a scientific adviser to Kennedy during the campaign, and he is believed to be willing to take a leave of absence as director of the Massachusetts Institute of Technology's Research Labora-

tory for Electronics. Kennedy also will have an early opportunity to make some changes in top Air Force posts. Chief of Staff Gen. Thomas D. White's term ends in June, and a chain reaction of top level shifts will take place when White's successor is chosen.

Clark Clifford is providing liaison between Kennedy and the present Administration while the President-elect prepares to take over. Kennedy doesn't plan to announce any further appointments until after Thanksgiving. But as he names his new cabinet, these officials probably will follow the pattern Truman and Eisenhower established in 1952 of having the incoming executives move into their departments as observers to overlap the retiring Republican officials. President Eisenhower also may designate certain of his administrators to stay with their departments for awhile after he leaves office to provide some continuity while the new Democratic officials learn their jobs.

Kennedy has had three briefings from the Central Intelligence Agency on developments in diplomatic, military and intelligence fields, and Sen. Johnson has had one briefing. Presumably, Kennedy could get White House permission for pre-inaugural briefings of such top officials as the new Secretaries of State and Defense.

Kennedy will have to deal with a potentially explosive competition for space roles between USAF and NASA shortly after he takes office (AW Nov. 7, p. 21). Air Force is pressing for a bigger military space role and is ready to take advantage of the civilian agency's publicly vulnerable aspects, such as the delays in Project Mercury, to back its case. A strong hand will be required in the White House to arrive at a sensible division of roles and missions in the inevitable overhaul of current space policy.

The results of this NASA-Air Force battle will depend to a great degree on the man who succeeds Keith Glennan as space agency administrator when he leaves Jan. 20. There are signs that Dr. Ernest C. Pollard of Yale University, a Kennedy adviser and chairman of the committee on science and technology of the Democratic Advisory Council, either will head the agency or have a significant role in choosing the new administrator.

President Eisenhower proposed changes in the National Space Act last spring, but Congress took no action. There will be much closer congressional scrutiny when the issue arises again next year, and chances are the changes will go beyond those contemplated by Eisenhower.

NASA is another agency that will get a supplemental appropriation request next year. It will cover new active and passive communications satellite programs which the agency wants to get under way, and possibly more support of basic research and other programs. Kennedy can use this supplemental request to show he is accelerating the space effort at the earliest opportunity —but the present Administration may beat him to the punch with a pre-inaugural supplemental request.

Democrats will be able to take over both the Federal Aviation Agency and the Civil Aeronautics Board quickly. FAA Administrator E. R. Quesada is scheduled to leave with President Eisenhower Jan. 20. He has won his bid for the recently vacated American League baseball franchise in Washington, but he may lose it by staying because he cannot engage in an outside vocation. CAB Member Maj. Gen. John S. Bragdon (USA ret.) leaves the Board on Dec. 31, and his replacement can give the Democrats a majority and the chairmanship. One prospect is Joseph P. Adams, former Democratic member of CAB and currently general counsel and executive director of the Assn. of Local Transport Airlines.

There are congressional investigations of U.S. aviation policy scheduled (see p. 25), and the new Administration undoubtedly will want to make another in the long series of over-all transportation policy studies. One good prospect for increased support is the airport aid program, due for renewal next year.

Sen. Johnson undoubtedly will wield great influence in space and military affairs because of his long experience with them. Johnson also plans to retain his current position as Senate majority leader until he becomes Vice President on Jan. 20. This will give him a powerful hand in organizing the Senate over which he will later preside as Vice President. His legislative experience will make him a valuable liaison between the White House and Capitol Hill.

When Johnson leaves his Senate seat, his departure from key committees will trigger a series of changes. He is chairman of the Senate Space Committee, and his post probably will pass to Sen. Robert Kerr (D.-Okla.). Sen. Richard Russell (D.-Ga.) and Sen. Warren Magnuson (D.-Wash.) are senior to Kerr, but they are barred from the job because they are chairmen of other committees. Sen. Clinton Anderson (D.-N.M.) also is senior to Kerr and would be interested in the chairmanship because of his long involvement with nuclear energy development. He is expected to pass up the space committee chairmanship, however, in favor of heading the Senate Interior Committee, which is more directly concerned with issues vital in his home state.

Sen. John Stennis (D.-Miss.) is in line to become chairman of the Senate Preparedness Subcommittee when Johnson leaves it. Sen. Stennis was leader in the fight to eliminate air defense missile duplication, which led to reductions in both the Army's Nike and the Air Force's Bomarc programs.

Sen. Mike Mansfield (D.-Mont.), currently the Democratic whip, is the leading prospect to take over Johnson's job as majority leader, but Sen. A. S. Mike Monroney (D.-Okla.) also is a contender.

Other key congressional positions were not disturbed by election results. Sen. Russell remains as chairman of the Armed Services Committee, and Rep. Carl Vinson (D.-Ga.) will be back as chairman of the House Armed Services Committee. Both of these legislators will be slow to accept any radical moves toward unification of the services.

The money watchdogs in the House all will be back. Rep. Clarence Cannon (D.-Mo.) will head the appropriations committee, with Rep. George Mahon (D.-Tex.) still in charge of the Armed Services Appropriations Subcommittee and economy-minded Rep. Albert Thomas (D.-Tex.) in charge of the subcommittee on appropriations for such agencies as FAA, CAB and NASA.

Chairman Overton Brooks (D.-La.) will continue to lead the House Science and Astronautics Committee next year, and all subcommittee chairmen will be back. This committee is expected to be considerably more aggressive next year than it has in the past.

Rep. Chet Holifield will take over chairmanship of the Joint Atomic Energy Committee from Sen. Anderson. He is expected to leave military applications to Subcommittee Chairman Sen. Jackson and research and development matters to Rep. Melvin Price (D.-Ill.).

Rep. Oren Harris (D.-Ark.) returns as chairman of the House Commerce Committee, and Rep. John Bell Williams (D.-Miss.) again will be chairman of the Transportation and Aeronautics Subcommittee. Rep. Williams plans an investigation this week of the Electra accident situation.

Eagle Contract

Washington—Navy awarded a $26 million contract for continued development of the Eagle air-to-air guided missile last week to the prime contractor, Bendix Systems Division.

Eagle will be 12-ft. long and 14 in. in diameter. It will weigh about 1300 lb. and will carry a warhead weighing more than 100 lb. It will have the capability of being guided by the launching Missileer aircraft to six enemy aircraft targets simultaneously up to 100 naut. mi. away and to altitudes of more than 100,000 ft.

Cessna Plans Addition of Three New Twin-Engine Aircraft by 1964

By Erwin J. Bulban

Wichita, Kan.—Cessna Aircraft Co. is planning to add three new airplanes to its line by 1964 and is adjusting its management concepts to cope with its growing model array—already largest in the business flying field.

To 1,200 distributors and dealers meeting here, Cessna lifted the curtain to some degree on how it plans to retain its present 50% share of the market. The new aircraft it will introduce in support of this goal and their approximate timetables:

- **Model 320,** a five-place higher-performance version of the present 310 light-twin series, to be powered by 260-hp. Continental supercharged engines. This airplane is planned to join the company's 1962 line.
- **Light-light twin** four-place high-wing design, with one engine in the nose and the other in the rear of a central fuselage, the twin tail supported on booms aft of the wing's trailing edges. Landing gear will be fixed tricycle type fitted with streamlined speed fairings or "pants." The light-light twin prototype has been completed and is undergoing preliminary engineering tests prior to start of flight test program early next year—probably in January. It is scheduled to be available to purchasers in mid-1962.
- **Heavy-light twin** 6-10-place low-wing model is projected to be ready in late 1963 or early 1964. Embodying "lightweight construction," this airplane has flat, low-profile engines and wingtip tanks, similar to the 310 configuration, and a single tail.

The new airplanes are obviously planned to fill in some gaps in the company's current large line, continuing Cessna's plan to provide a product in every category so that its customers can move up from one model into the next class without having to venture outside the "family."

Stepping Up

The new 320, for example, will make it possible for Cessna 310 users desiring greater capacity and speed to step up to this new airplane, which is obviously intended to offset the new forthcoming Beech Baron light-twin five-place development of the Travel Air, which will be powered by 260-hp. Continentals. Beech is announcing the Baron at its annual distributor-dealer meeting this month.

The light-light twin is particularly aimed at the Piper Apache class, which serves to minimize transition problems of the single-engine business aircraft user who seeks to step up to multi-engine operation. Cessna expects the airplane to be directly competitive in price with the Apache. A tandem-engine configuration was finally chosen over conventional wing-mounted engine pairs primarily because Cessna engineers decided that this was the optimum layout from a safety standpoint, providing engine-out performance without degradation of handling characteristics, particularly the yaw moment. Layout is seen by company engineers as providing same flight characteristics, engine out, as a single-engine airplane, since the two powerplants are in line. Piper's new entries in the business plane market are described on p. 128.

The configuration, along with high-wing design, is seen as providing distributors and dealers with an important sales tool when the airplane reaches field inventories.

The company's experience has been that its philosophy thus far of maintaining certain important characteristics throughout its single-engine line, such as the high wing, all with the identical NASA 2412 airfoil section, identical flap and spring-steel-type fixed landing gear, has paid off. This is because of the simple transition the customer has had in stepping from the lower-performance to higher-performance models due to their close aerodynamic and handling characteristics.

Powerplant Not Chosen

It is felt that the high wing tandem-engine layout will again smooth the dealer's task in moving his single-engine Cessna prospects into the new multi-engine class. Cessna has not yet chosen a specific powerplant for the new tandem-engine airplane and indications are that the study has embraced turbine as well as piston engines—and in the latter class, six and eight-cylinder, geared, ungeared, supercharged and unsupercharged configurations.

Company spokesmen say that the new products will be added onto the current line of 12 airplanes, adding that presently they do not foresee, at least for the next several years, the dropping of any of the current line. Implication is that by 1963-1964, Cessna will be producing 15 business aircraft models. This, in turn, has industry observers believing that Cessna may in the future go to a divisional-type organization structure, much like General Motors developed in the automotive field, to ease the burden of factory and dealer faced with a complex inventory problem.

Some Cessna officials admitted to AVIATION WEEK that this concept is getting considerable attention of company management—but they indicate that a decision on details of such a structure are still pending.

Continued product line expansion, along with plans to increase production, firmly backed up optimism expressed by Cessna officials for continued growth in the business aircraft field. Company president Dwane L. Wallace told the field organization that he had no doubt that 1961 will be the greatest year in Cessna's history.

Taking heed of rumblings today about the instability of economic conditions, Wallace likened the situation to 1958 "when the doom forecasters were standing at the wailing wall crying "recession." He said, "we didn't believe it. . . . Our salesmen wore badges that said, "business is good" and it was . . . and it stayed good. Why? Because we made it good . . . and when 1958 ended, it was another record year and, for some reason strange to the rest of the world, the recession didn't affect us."

Growth Business

Noting that economically and organizationally the company is in a better position that than it has ever been, with more customers and prospects than at any time in its history, Wallace said that the company had the added plus of being in a growth business, adding, "when you're going uphill, it's no time to take your foot off the gas."

To give the sales force an idea of the market that lies ahead of it, Cessna officials stated that careful surveys by the company indicate a current potential volume of more than 293,000 business aircraft, representing that many new sales in the offing to prospects who do not now have, but have a requirement for, business aircraft. It was estimated that this total could be broken out to some 262,000 single-engine types and 31,000 multi-engine airplanes.

A significant uptrend in new-owner sales was pointed out by Marketing Division Manager Frank Martin who noted that last year nearly 40% of Cessna dealer sales of new and used aircraft went to this category, whereas some six years ago it was approximately 24%.

He expects that this year new owners will account for about 43% of all Cessna dealer sales.

Current planning calls for increasing production to over 4,000 units in Fiscal 1961, compared with last year's 3,700, and this appears to be a conservative estimate considering the favorable business aircraft market barometer, the fact that Cessna dealers are starting their new model year with low inventories of last year's models, and an indicated

continued good increase in export sales.

The light-twin Model 310 field inventory situation improved so much at the close of the sales year that Cessna announced it was moving previous planned introduction date of the 310F back from Jan. 15 to Nov. 20. Factory sales of airplanes to its field organization also were impressive. At the conclusion of the distributor-dealer meeting here, some 350 demonstrator models worth more than $4 million made a mass flyaway from the factory. They were some of approximately 630 new Cessnas which will have been accepted for delivery between the last week of October and the end of November, according to Frank Martin. Company sources indicated that the factory already had booked wholesale orders from its sales organization for nearly half of its scheduled 1961 production prior to the flyaway.

Cessna's export sales also continue a healthy rise—Fiscal 1960 showed a volume of some $9.25 million, compared with the previous year's $4.6 million, according to Export Manager M. F. Mellinger. Reduction in import restrictions is playing an important role in this increased volume, with foreign countries gradually learning that it is poor policy to restrict outflow of dollars for business and utility aircraft because the relatively few dollars spent now will reap considerably more dollars later as a result of more rapid growth of business and aids to agriculture that the airplane can provide.

Important areas such as Australia, Argentina, Africa, New Zealand and Uruguay have seen the light and lowered the previous bars to a significant extent—Australia, which had been on very restrictive basis, basing aircraft imports on a low quota basis, with requirement that the aircraft be sold prior to being granted import licenses, has gone on a "pipeline" supply basis, with Cessna sending eight aircraft monthly to this country.

Increasing foreign trade is stimulating use of business aircraft abroad, but due to dollar and other restrictions, Cessna has not even been able to touch the demand, let alone the potential, Mellinger stated.

Cessna has approximately 78 distributors and dealers in some 60 foreign countries now—and these sales outlets are gradually building facilities and acquiring the necessary sales and service know-how. Airwork Services, Great Britain, which was named a Cessna distributor only a year and a half ago, has increased its business to the point where it is reorganizing its operations to separate its business aircraft activity completely from its other aviation activities to provide better concentration of effort. British business is building rapidly; in the past year Cessna delivered 20 airplanes valued at approximately a half-million dollars. Mellinger believes that this year the company will ship 50 airplanes to Britain.

National Aero Finance Co., wholly-owned Cessna subsidiary, has fairly well stabilized its volume, as regards percentage of airplanes it is financing wholesale and retail, although over-all dollar volume currently runs $7-$9 million and is expected to increase to $11-$12 million over the next two years.

Basic reason for stabilization is that most of the company's distributors have developed financing connections with their local banks, which is the procedure NAFCO prefers. NAFCO was primarily set up to tide the field sales organizations over at a time when local banks did not look as favorably on financing private airplanes as they do now. Much of its activity is in supplying financing to the distributor or dealer when his volume has reached the point where the local bank feels it does not want to go over what it considers a certain percentage or volume of aircraft business but wants to maintain a certain balance in its loan portfolio.

But as the well-established dealers develop their own local finance sources, NAFCO is helping newly established dealers until they reach the same period of confidence with their local money lending sources, so that NAFCO is financing some 35-40% of the aircraft leaving the factory, approximately the same percentage as a year ago.

NAFCO's primary mission is to tide the Cessna dealer organization over whenever it reaches some point of sales where financing begins to be a stumbling block. The subsidiary currently is developing a further assist to dealers —this area comprising a retail financing plan for used aircraft to enable dealers to broaden their sales efforts and providing another important sales tool.

Production JetStars Readied for Flight Tests

Three production Lockheed JetStar turbojet transports and the prototype (with Lockheed markings) are shown on the Marietta, Ga., plant ramp for final adjustments to avionic and slipper tank gear. Aircraft are being used for Federal Aviation Agency certification test programs. In left background is a C-130 Hercules with long range fuel tanks under wings.

Step Toward Control Of Fusion Reported

Berkeley, Calif.—Important step toward the goal of fusion power, a controlled thermonuclear reaction which lasted for one-thousandth of a second, has been reported by scientists at the University of California's Lawrence Radiation Laboratory. The reaction, which achieved temperatures estimated at 60 million deg. F, was obtained in a two-stage magnetic mirror machine which uses pulsed magnetic fields to compress, heat and confine the deuterium plasma.

The relatively long duration of the reaction, indicating stable plasma confinement, coupled with the production of neutrons which confirmed theoretical predictions, leads scientists to conclude that a controlled thermonuclear reaction has been achieved. About four years ago, British scientists reported a controlled thermonuclear reaction but later conceded that these claims were premature. Lawrence Radiation Laboratory scientists intend to expand the magnetic mirror machine to three stages in an effort to produce higher plasma temperatures and longer reaction intervals.

Little Joe Test of Mercury Capsule Fails

By Edward H. Kolcum

Washington—Second successive setback in the Project Mercury test flight program came last week when an electrical circuit failed under high aerodynamic loads, preventing separation of the capsule from its Little Joe booster and delaying critical demonstration of production capsule structural integrity.

National Aeronautics and Space Administration obtained enough telemetry data on the flight to establish cause of the failure of capsule and booster to separate as a separation switch failure. Immediate effort was begun to correct the defect by change in wiring or switch redesign.

The flight will be repeated as soon as possible, since data on the ability of the capsule to withstand maximum dynamic pressures is considered necessary to qualify the capsule.

Test at Wallops Island, Va., was the fifth and last NASA had scheduled in the Little Joe booster series. Earlier flight reversal occurred in July when a test of the production capsule structure in a high angle re-entry could not be made because of an Atlas launch vehicle failure (AW Aug. 8, p. 26).

Mercury-Redstone Delay

Washington—Scheduled test of Redstone-boosted Mercury capsule (MR-1) was postponed last week because of a leak in the attitude control gas system. This system flips the capsule around 180 deg. so the blunt face is forward during re-entry.

Redstone test is a prelude to suborbital Mercury pilot training flights with Redstone, at least one of which is to be made before manned orbital flight in the Mercury program.

Qualification Test

Flight last week was designed to qualify the production capsule in an escape maneuver at low altitude—48,000 ft.—where the maximum dynamic forces occur. Structure was to have been subjected to pressure of 1,000 psi. and 20g loading.

Atlas-boosted high angle re-entry flight also will be repeated.

Wallops firing team can put together a Little Joe booster with available motors and hardware, since six booster systems were delivered and only five were fired. A seventh Little Joe booster is on order, but no mission has been assigned.

Decision was made last week to repeat the test with Little Joe, but an alternative would be to conduct maximum pressure maneuver with a Redstone booster, since the all-solid propellant Little Joe has about the same performance characteristics as Redstone and not all eight Redstones purchased for Mercury have been assigned specific missions.

Redstone test would be conducted at Cape Canaveral because ground equipment is available there for the liquid rocket and Wallops has no experience with large liquid engines.

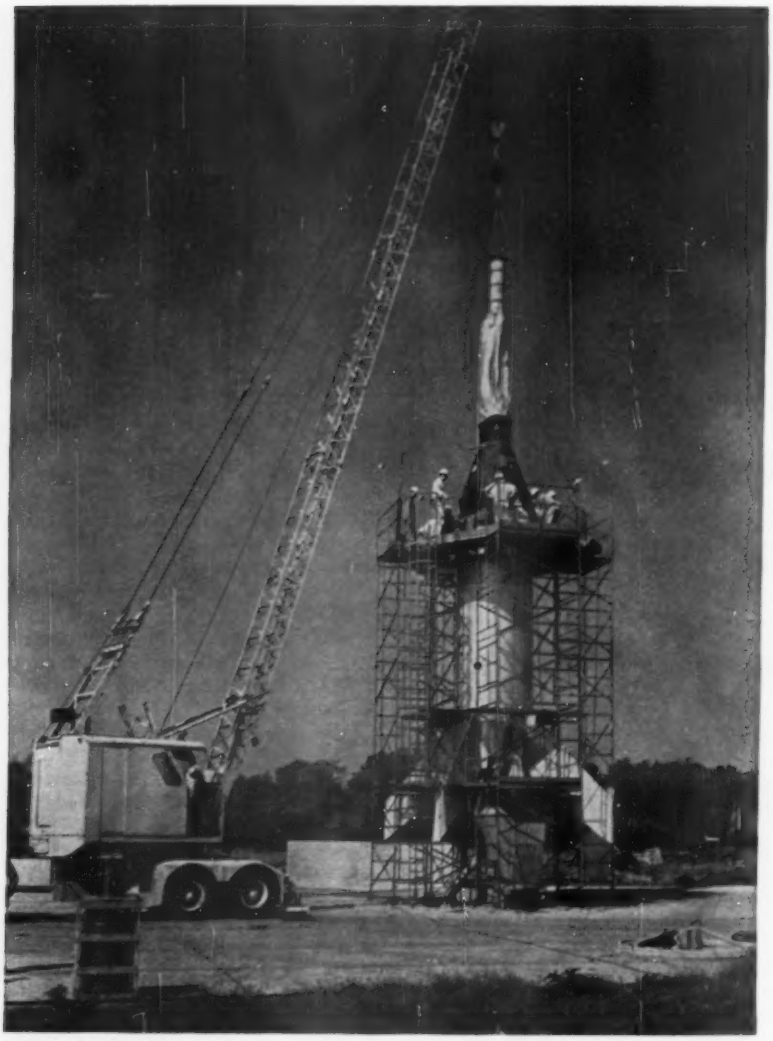
Current test series is aimed at qualification of orbital hardware produced by McDonnell Aircraft Corp. for NASA, emphasizing demonstration of structural strength under various loading conditions. Earlier Little Joe flights subjected NASA-produced capsules to high loads to verify capsule design and flight-qualify escape and parachute landing systems.

Capsule Configuration

In the flight last week, a beryllium heat shield was used on the capsule, but ablation material will shield the manned orbital vehicle. General exterior structural arrangement of the Little Joe capsule was identical to the manned satellite except for the shield and shape of the porthole. Porthole is round in the first five McDonnell capsules, and was redesigned to be larger and rectangular in subsequent satellites.

Booster-capsule separation was to have occurred 25 sec. after launch. Ten seconds later, the escape sequence was to have been initiated with the capsule at an altitude of 35,000 ft.

Burned-out Little Joe, with capsule and escape tower still attached, was



PRODUCTION MODEL of Mercury space vehicle is mounted atop Little Joe booster at Wallops Island, Va., for test of the structural integrity of the capsule and its escape system.

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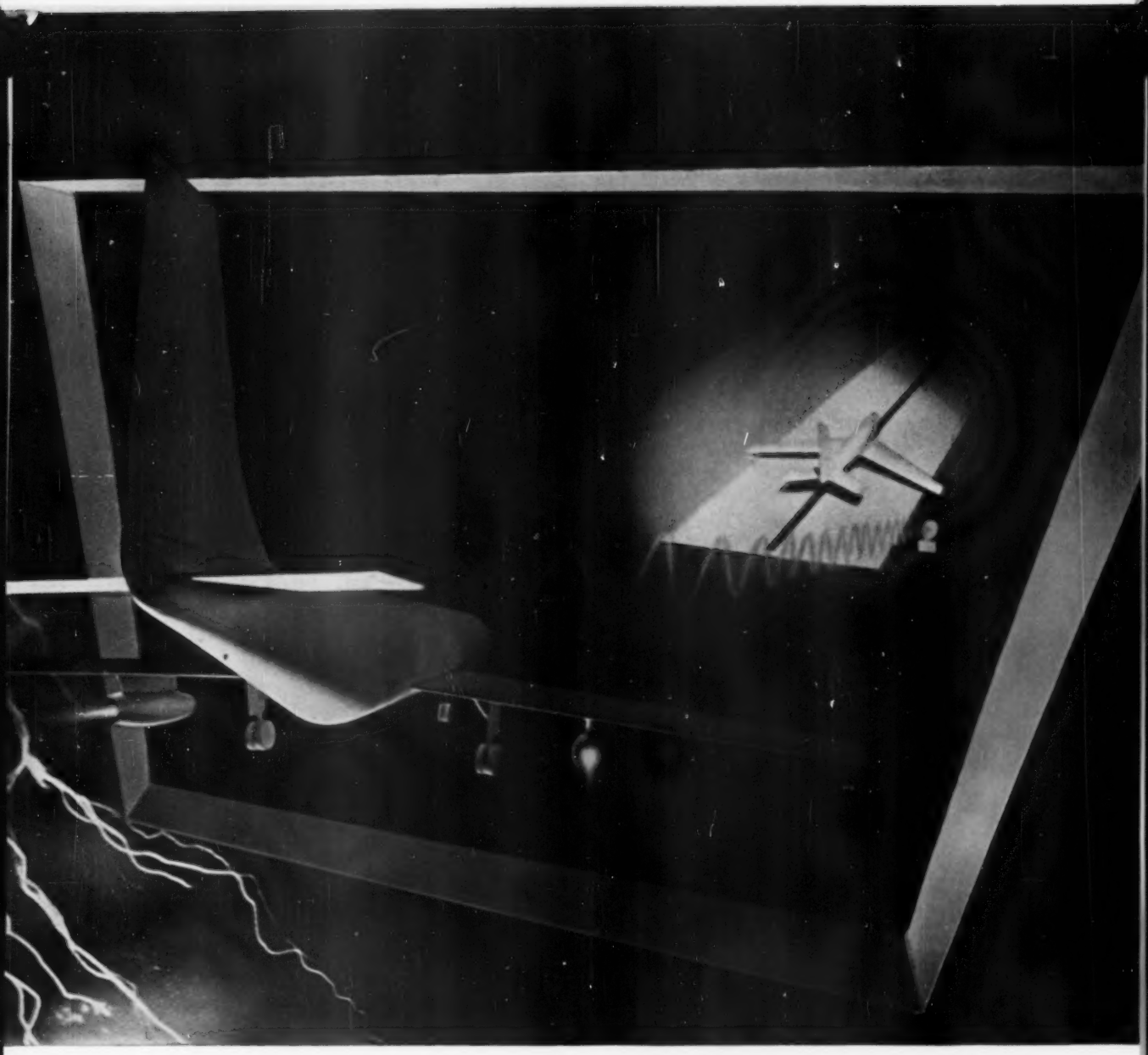

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Unlike other automatic landing systems, the Bell ALS is ground-based so a ground observer monitors every approach and landing. It can operate either fully automatically or under pilot control.

Military versions of the ALS have been ordered by the Air Force. The Navy has selected it for installation aboard the nuclear-powered aircraft carrier USS Enterprise as well as for its other large carriers.

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B-70 Subcontractors Reinstated

Los Angeles—North American Aviation quickened negotiations on new contracts with a number of former subcontractors last week in an effort to assure an orderly resumption of work on the B-70 supersonic bomber.

A number of contractors who were dropped from the North American team after the B-70 cutback late last year are now reinstated and others are expected to follow momentarily. The dollar values of the new contracts have not been settled, according to North American. Among the contractors already reinstated and their system responsibilities are:

- **Sperry Gyroscope—auxiliary gyro platforms.**
- **Hamilton Standard Division of United Aircraft—air induction control and environmental control system.**
- **Federal Systems Division, International Business Machines Corp.—bomb navigation and missile guidance subsystem.**
- **Western Military Electronics Center, Motorola—mission and traffic control subsystem.**
- **Westinghouse Air Arm Division—defensive subsystem.**

IBM's Federal Systems had been working on the bomb-nav subsystem under a direct government contract after last year's B-70 cutback. This direct contract will effectively be replaced by the North American subcontract.

Other major B-70 systems for which new contracts are being negotiated with potential subcontractors by North American are the secondary power system, flight augmentation system, landing gear, engine air ducting, alert pod and fuel management system.

tracked to 53,000 ft. altitude, and then it tumbled into the Atlantic about 13 mi. from Wallops. Near the scene was the USS Opportune, a Navy salvage and rescue vessel, and three Marine HUS helicopters.

Salvage attempts began immediately for the booster-capsule system, which had a weight of about 25,000 lb. on impact and probably broke apart.

Marman band joining capsule and booster is supposed to break apart with ignition of three explosive bolts. In an escape maneuver sequence, posigrade rockets do not fire as they would in a normal flight to carry the capsule away from the booster after separation. The escape rocket performs this operation in an abort, and it is designed to pull the one ton capsule about 2,000 ft. away from the booster.

There was telemetry indication that the escape rocket ignited, and apogee was about 5,000 ft. higher than programed. It is unlikely that the escape tower was jettisoned, as was planned.

Launch was delayed a day because of bad weather, and the flight was made under variable wind conditions. High winds over the beach caused launch angle depression of 2.5 deg. to 80.5 deg. Actual impact at 13 mi. was 5.5 mi. farther than planned.

Eight-motor Little Joe vehicle contained six live and two inert rockets. Four live Recruits and two Castors, all ignited on lift-off, provided thrust of about 250,000 lb.

Test was the seventh rocket-boosted vehicle shot in the Mercury program, four of which have provided the desired data, one considered partially successful and two unsuccessful.

Summary of flights:

- **Big Joe,** launched Sept. 9, 1959, successfully demonstrating design characteristics and ablation-type heat shield with an Atlas booster.
- **Little Joe I,** launched Oct. 4, 1959, qualifying eight-motor booster with full-scale capsule model.
- **Little Joe II,** launched Nov. 4, 1959, in partial success with a high dynamic pressure abort maneuver, using a boilerplate model.
- **Little Joe III,** fired Dec. 4, in successful test of escape system at high altitude, with the boilerplate model, containing a monkey.
- **Little Joe IV,** launched Jan. 21, in high pressure abort, with a monkey on board.
- **Mercury-Atlas I,** launched July 29, in an unsuccessful high angle re-entry test of a production capsule.
- **Little Joe V,** launched Nov. 8, in an unsuccessful high dynamic pressure abort with a production capsule.

One additional McDonnell capsule was tested in an off-the-pad abort maneuver May 9. No booster was used in this successful test.

Navy Reports Gain In ASW Capability

Explosive rates of technological advance have given the U.S. Navy much more anti-submarine capability today than just a few months ago, Rear Admiral Lloyd M. Mustin told a New York meeting of the National Security Industrial Assn. last week.

Mustin, who is ASW Readiness Executive, Office of the Chief of Naval Operations, claimed emphatically that U.S. capabilities in the field of undersea warfare were "miles ahead" of any similar Communist-bloc capabilities. Only if the Communists were to convert their entire fleet of approximately 500 submarines of all types to nuclear power would they pose any real threat to the U.S., Mustin added, and underlined that this could not be done overnight.

Total U.S. effort on ASW now includes units operating wherever there are naval operations afloat, he said, and gave over-all strength figures of 1,300 aircraft, nine carriers, 268 surface ships of the destroyer category and 107 submarines with anti-submarine capabilities.

Underlining the importance of cooperative sub-killing, Mustin said that in ASW, one airplane and one submarine add up to much more than twice the capability. In recent maneuvers, combined operations showed team figures of 10 times the capability of single efforts, and the admiral said this figure could be as high as 20 to 50 in specific cases.

Future technical growth in the field is expected to be in the electronic gear needed for the complex job of underwater detection, and the further development of "silent" machinery. Current aircraft, helicopters and blimps, either in service or about to be produced, satisfy the need as carrying vehicles.

Mustin credited intelligence and Russian geography as the two biggest factors aiding the Navy in its continuing assessment of Russian strength and capability.

Beryllium on Mercury

Washington—Parachute housing section of the Project Mercury manned satellite is now covered with beryllium to protect it from the highly localized heating expected in this area during re-entry.

Original design called for the capsule afterbody to be fabricated of cobalt alloy, shingled and corrugated for stiffness and expansion during heating. Main afterbody and conical drogue chute sections still are covered with cobalt alloy shingles.

National Aeronautics and Space Administration said the change to beryllium for the main chute section resulted from data obtained from the Sept. 9, 1959, Big Joe flight, which indicated peak temperature of 2,300F on the parachute housing, compared with 1,000F on the main afterbody and 1,800F on the drogue sections. Three afterbody sections contained 52 thermocouples to measure heating histories.

Engine Malfunctions Halt Blue Scout Test

Washington—Attempts to test the second four-stage Air Force Blue Scout high altitude probe failed last week when the second stage cut off prematurely and the third and fourth stages did not ignite.

Programed to reach 24,000-mi. apogee and travel 5,500-mi. down the Atlantic Missile Range in a 10 hr. 10 min. flight, the vehicle landed instead about 250 mi. from the launch pad after flying just a few minutes.

Test was the second of 12 in the USAF solid propellant Blue Scout development series which is expected to lead to a 35-vehicle annual launch schedule over the next several years.

Configuration of the vehicle, designated Blue Scout Jr., or Hyper-Environmental Test System (HETS) 609A D-2, was identical to the first system launched in September (AW Sept. 26, p. 29). Air Force Special Weapons Center radiation measurement payloads were similar, but the 29-lb. package carried by D-2 was 3.8 lb. lighter than D-1 payload.

After the D-2 flight, Air Force said the D-1 test was not a complete success because exhaust from fourth-stage nozzles melted some of the soft solder in telemetry circuitry. Data on vehicle performance and from the scientific payload were telemetered up to 8 sec. before fourth-stage burnout, near the planned 16,000-17,000-mi. apogee.

Blue Scout is the name USAF has given six vehicle configurations using much of the same hardware in the National Aeronautics and Space Administration's Scout launch vehicle (AW July 11, p. 54). Unlike the fully-guided NASA Scout, designed primarily as a small satellite booster, Air Force HETS 609A family consists of both unguided and guided systems.

Both D-1 and D-2 were unguided, and they consisted of Thiokol XM-33 Castor first stage; Hercules-Allegany Ballistics Laboratory 254 Antares second stage; Aerojet-General 30 KS-8,000 third stage, and a 17-in. diameter spherical fourth stage developed by Naval Ordnance Test Station.

D-2 test launch was made by USAF and Ford Aeronutronic Division which has contracts for systems integration and payload carrier design.

Army Aviation Plans

Washington—Army has a firm requirement for a helicopter crane with a 10-14 ton payload, and development—postponed until now because of expected high costs—"soon may be forced upon us," Richard S. Morse, Army's director of research and development, said last week.

Army also plans to initiate development next year of a combat surveillance aircraft with greater performance than the Grumman Mohawk. Morse said he felt reasonably sure this vehicle would have "unique takeoff characteristics with the speed capability at low altitude which will assure its survivability."

A third new development anticipated is a transport no larger than the de Havilland Caribou but with "considerably more capability." Configuration and design will be influenced greatly by the current Tri-Service V/STOL program (see p. 23), Morse said.

USAF Airlifts Relief Aid to East Pakistan

Evreux, France—Air Force's 322nd Air Division headquartered here touched off its third emergency airlift of the year last week ferrying relief supplies to cyclone-ravaged East Pakistan.

Six Lockheed C-130 turboprop transports of the 322nd took off from Rhein Main Air Base, Germany, and Chateauroux Air Base, France, bound for Dacca, East Pakistan, with a total of 75 tons of relief supplies, including sulfa drugs, anti-malaria pills and blankets, from U.S. Army stocks in Europe.

C-130s required approximately 20 hr. flying time over the 6,000 mi. route to Dacca, with stops scheduled at Athens, Teheran, Karachi and Calcutta. Supplies will be distributed to refugees along the Bay of Bengal coast which was struck by two severe cyclones within a three-week period.

The 322nd, combat transport arm of U.S. Air Forces in Europe, delivered 1,000 tons of supplies and equipment to Morocco in March after the city of Agadir was almost completely destroyed by earthquake. Late last summer the 322nd went on wartime footing to ferry troops of 14 nations into the strife-torn Republic of Congo.

Fairchild Engine Splits Engineering Activities

Further reorganization of Fairchild Engine and Airplane Corp. in which its engineering operations will be split into two separate groups is under way as part of an intensive cost-cutting and management overhaul of the company (AW Oct. 24, p. 27).

One of the separate groups will centralize the company's drone program activity, primarily the Army AN/USD-5 project, under direction of John C. Parkin, project manager of the SD-5. The other group, general engineering covering existing programs as the F-27 turboprop transport, B-52 subassemblies and radar antennas, will be headed by Nicholas M. Stefano, formerly chief project engineer-design.

Armand J. Thieblot, who rejoined the company a year ago as head of the engineering department that had just been consolidated at that time, has resigned.

News Digest

First Polaris A2 test vehicle flew more than 1,600 mi. down the Atlantic Missile Range last week. Missile had a Hercules-Allegany Ballistics Laboratory second stage motor with a glass fiber case and a higher specific impulse than the A1 missile's second stage solid propellant.

First Minuteman solid propellant ICBM squadron, with 55 missiles in underground silos, will become operational in July, 1962, one year earlier than previously planned.

United Aircraft Corp. sales for nine-month period ending Sept. 30, 1960 totaled $738,818,308 compared with sales totaling $796,494,872 for the similar period in 1959. Net income amounted to $10,864,815, or $1.53 per share, compared with $23,151,648, or $3.45 per share, for the same nine-month period in 1959.

John B. Montgomery, former vice president and general manager of General Electric's Flight Propulsion Division, has been named president of Daystrom, Inc., effective Dec. 15. Thomas R. Jones, formerly Daystrom's president, has been named chairman of the board and will continue as chief executive officer.

Missiles-Jets & Automation Fund will be taken over by the Axe Science and Electronics Corp. The investment company, organized two years ago to buy securities in the growth fields of rocketry and electronics and with Dr. Theodore Von Karman as chairman of the board, asked the Securities and Exchange Commission last week for an order declaring that it has ceased to be an investment company.

Motorola Military Electronics Division and Douglas Missiles & Space Systems Engineering Department have undertaken a joint study to establish next-generation design criteria and maintenance philosophy for future Air Force weapon systems plus associated test and checkout equipment.

Phoenix sounding rocket, developed by Rocket Power/Talco, a division of Gabrial Co., climbed to an altitude above 246 mi. during Oct. 27 flight from Pt. Arguello, Calif.

Latin American Traffic Struggle Grows

Meeting of governments fails to reach compromise; new South American group intensifies the problem.

By L. L. Doty

Washington—Deep-rooted struggle over rate levels and traffic capacity on Latin American routes appears to be gaining momentum despite a second attempt late last month by governments involved to reach some compromise settlement for airlines serving the southern continent.

In a poorly attended meeting of South and North American states held in Montivideo Oct. 24 and 25, some agreement was reached on a number of traditionally controversial issues, but generally, sharp lines of differences were drawn that dampened most hopes for any early solution to the rate and capacity problem. The battle between the governments has been intensified by the Conference Internationale de Transportedores Aereos (CITA), which has forced its stand against International Air Transport Assn. tariffs and standards on three Latin American governments.

The action by CITA, a group of non-IATA airlines led by Aerolineas Peruanas (ASPA), which has the full backing of the Peruvian government, threatens to prolong a rate-cutting war that already has kept air transportation in Latin America in a state of imbalance for at least four years. CITA has drawn the support of Ecuador and Uruguay in addition to Peru and has sporadic backing of Panama, although the threatened withdrawal of Aerovias Panama from the group has weakened the organization. In addition, the decision of INI, an Argentinian carrier, to join IATA was a serious setback to CITA.

Nevertheless, because the Montivideo meeting, called the regional civil aviation conference, was attended only by Argentina, Brazil, Colombia, Ecuador, Panama, Peru, Venezuela and the U. S., the impact of the rebellious group was strong enough to influence decisions. Chili was represented as an observer.

Chief issue at stake is the drive by non-IATA carriers to sustain a passenger fare level 20% below that authorized by IATA. Strategy of the IATA traffic conference at Cannes earlier this fall (AW Oct. 24, p. 41) called for a reduction of coach fares in South America by as much as 35% below current levels effective Apr. 1 to make any further price-cutting by non-IATA carriers economically impractical.

At the same time, IATA authorized an increase up to 10% of first-class fares in Latin America and established a fare differential between turbojet flights and propeller-powered aircraft flights. In addition, in a compromise gesture toward local Latin American carriers, IATA said it would consider the application of fares 10% below the new coach fares provided seat pitch is held to 34 in. and all service frills are eliminated.

CITA members have vigorously attacked the IATA fare table, which was the only tariff on hand at the conference for discussion, on grounds that it was economically damaging to CITA members who must, they claimed, operate at fares lower than competitors in order to generate sufficient traffic to stay in business.

In an attempt to reach some solution that would compromise these differences between the airlines and still establish a uniform scale of rates, the regional civil aviation conference made these recommendations:

• **Provision calling** for a 10% differential in passenger fares for carriers considered to be "under-developed" by their respective governments should be retained until Mar. 31. Principle of lower fares for under-developed airlines was introduced in accordance with IATA traffic conference resolution adopted in Honolulu in 1959 and an agreement reached earlier that year in Lima by carriers serving Latin America. Chief problem lay in the fact that the term "under-developed" lacked a refined definition so that it was not always possible to determine which carriers rightfully belonged in this category.

• **Governments should consider** approving one of three rate tables by Apr. 1: rates agreed to at Cannes, any rates submitted by other carriers or carrier or rates developed through a joint meeting of the carriers which the conference endorsed.

• **Governments should take** all necessary steps to ensure that any rates agreed upon are properly put into effect under rigid governmental supervision.

The proposal for a joint meeting of the carriers drew strong opposition from the U. S. The U. S. delegation held that, while it supported a meeting of carriers in principle, it opposed the proposed meeting on grounds that the scope of such a meeting had not been adequately delineated.

In an obvious reference to the CITA group, it further argued that the obvious intent of such a meeting was to seek to raise the new low fare level established at Cannes. This, of course, would enable the CITA group to set its own rate level 20% below the IATA fares without creating a damaging depression of revenues. The U. S. delegation said it would support the new IATA fare level as being in the public interest and a contributing factor in the growth of air transportation between the U. S. and Latin America.

U. S. said it could not agree that a small minority group should be allowed to contest rates that have been approved by 95% of the world's international flag carriers. And the delegation said it saw no reason for a meeting of carriers to introduce a third tier of reduced fares with restricted seat pitch and an austere service. Such a level could be created without another carrier meeting, the U. S. argued.

During the course of the meeting, the majority of the governments took the position that the economic and financial difficulties plaguing Latin American airlines were attributable to excessive capacity and that most governments now were anxious to impose some control over passenger traffic. As a result, the conference adopted these recommendations on the subject of capacity:

• **Governments should provide** positive

Lufthansa Reorders Boeing 720Bs

Cologne, Germany—Lufthansa German Airlines has ordered four more Boeing 720B jet transports, raising the total ordered to eight. Deliveries are expected to begin next year.

The medium-range 720Bs will be used on Lufthansa's South Atlantic, Near East and Middle East routes.

Lufthansa's jet fleet now comprises four Boeing 707-320s, with a fifth 320 scheduled for delivery next spring.

protection over traffic to and from their respective countries through stiffer enforcement of capacity clauses contained in various bilateral air transport agreements.

• **Governments should adopt** measures that will prevent air carriers from generating capacity which is in excess of that considered adequate for basic traffic.

• **Provisions should be made** to permit governments to impose restrictions of flight frequency or establish maximum quotas on salable seats on carriers which violate capacity standards.

Colombian Condition

Colombia supported the recommendations on condition that capacity restrictions apply only to traffic from country to country and not to traffic headed for third countries. The U.S. held that the capacity issue was out of order as an item on the conference agenda since it implied undertaking a multilateral agreement that could be in contradiction with the bilateral agreements under which U.S. carriers are now serving Latin America. The U.S. also took sharp issue with the basic assumption that a problem of excessive capacity now existed on routes throughout the continent.

In general, the character of sessions devoted to capacity took on a strong anti-U.S. flavor.

Recommendations were offered to impose limitations on the volume of traffic that could be actually carried from one country to another. Such traffic, including Third and Fourth Freedom traffic, under the original recommendations would not exceed 25% of regional traffic. The recommendations also call for the exchange of origin and destination traffic statistics to enable the governments to maintain adequate control.

Venezuelan Support

Venezuela supported the recommendations but reserved the right to exchange 100% of Third and Fourth Freedom traffic exclusively with another country. The U.S. went on record with strong opposition to the recommendations on grounds they were in complete variance with U.S. civil aviation policy and concepts developed in bilateral agreements with other countries. It noted that principles governing the regulation of traffic were already contained in such bilateral agreements and warned that it would definitely oppose formal adoption of the recommendations by the conference.

As a means of maintaining control over tariffs and to prevent illegal price-cutting, the conference recommended the establishment of an agency or authority by each government with the power to investigate tariff violations and penalize violators. It further recommended that companies charged with violation of tariff filings be given the full right of self-defense.

It recommended that when a government penalizes a company of another nation, aviation authorities of that nation should be told of the facts behind the penalty. It recommended that the states should follow through on infractions in this order: warning, fine, temporary suspension of commercial rights and, finally, cancellation of air carrier permit.

A recommendation was approved calling for the adoption by all the governments of the Western Hemisphere of an American Aeronautical Code to consolidate various civil aviation policies and international aviation law. In this connection, it was recommended that governments maintain active representation in the work of the legal committee of the International Civil Aviation Organization.

Solution Distant

Although the recommendations of the conference are promising evidence that some headway is being made toward rate stabilization and the institution of operating standards in Latin America, the light representation at the conference coupled with the determination of some carriers, backed by their governments, to continue to wage a price war lead many observers to feel that the South American civil aviation problem is far from being solved.

Recommendations reached by the conference delegations must be approved by their governments before they can be put into effect. Sharp differences on some issues, and the wide scope covered by a number of recommendations, suggest that some proposals may be changed in the process of winning government approval so that complete standardization may not result.

Western Signs Pact With Railway Clerks

New 41-month labor contract, providing for pay increases and changes in work rules, has been signed by Western Air Lines and the Brotherhood of Railway Clerks. The agreement covers approximately 1,200 of Western's 2,850 employes in the airline's domestic cities. The contract is effective from Feb. 1, 1960, to June 30, 1963.

The settlement provides for three-step pay hikes, effective Nov. 1, 1960, May 1, 1961, and May 1, 1962. In addition, employes will receive retroactive pay for the nine-month period from Feb. 1, 1960, to Nov. 1, 1960, the time that the new agreement was under discussion.

TCA, Canadian Pacific Revise Fare Structure

Montreal—Trans-Canada Air Lines and Canadian Pacific Airlines are filing new North American tariffs under a sweepingly revised fare structure that is based on a cost curve principle relating fares to actual operating costs on various routes.

Developed by TCA, the new structure will mean fare reductions on most long-haul routes. Fares on 400- to 600-mi. segments will stay about the same; under-400-mi. fares will increase. The new structure also will include institution of economy class travel on all trans-border routes. Another innovation is seasonal excursion fares within Canada at a 25% reduction under the new regular fares.

Baggage allowances also will be liberalized. In the economy class, allowance will be increased from 40 to 44 lb. In first-class service, the allowance will rise from 40 to 66 lb. Excess baggage charges will be based on 0.5% of applicable economy fares, instead of 0.5% of first-class fares as determined at present.

The economy class fares will affect competition with Eastern Air Lines on the New York-Montreal route and American Airlines on the New York-Toronto route. TCA has been offering only first class services on these routes, while Eastern and American both now offer coach services.

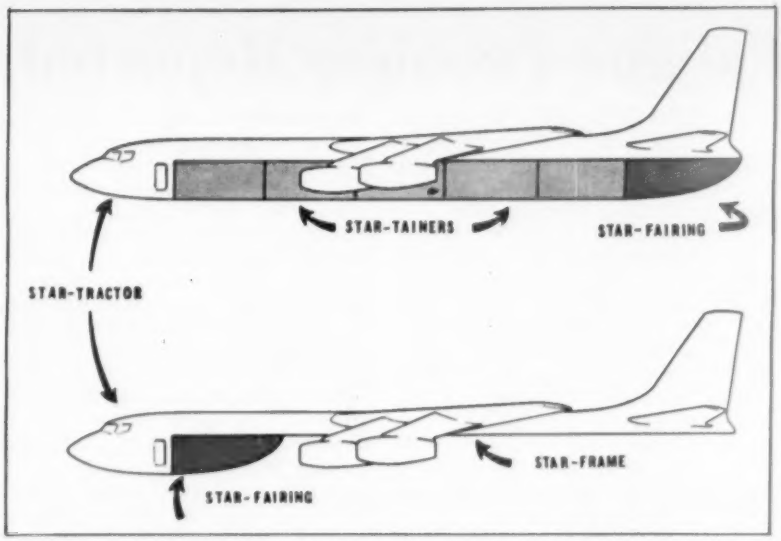
Other trans-border cities involved are Boston, Cleveland, Chicago, Detroit/Windsor, Tampa and Seattle.

TCA said it has been working for a year on its composite cost curve for Douglas DC-8 jets and Vickers Viscount and Vanguard equipment, applying the curve to all North American routes to arrive at a per-mile tariff for each flight leg. Under the system, TCA said, economies of long-haul travel will be passed on to the passenger. Fares on very short routes will not unconditionally adhere to the cost curve principle, but will come closer than in the past to meeting the actual cost of operation.

Trans-Canada said the new structure will result in lower unit return per passenger mile, but the new fares should attract new volumes of passenger business.

With no surcharge on its jets and no federal transportation tax as in the U.S., New York-Vancouver DC-8 fare (via Viscount to Toronto) will be $212 round trip, or considerably lower than a U.S. jet fare of $277.20 between New York and Los Angeles, according to TCA.

Trans-Canada's economy class seats in its DC-8 jet transports comprise two-thirds of the total passenger capacity.



FREIGHTER with detachable lower fuselage section would carry reserve fuel along longitudinal axis of airframe to permit weight transfer within center of gravity range.

Cargo Aircraft Would Transport Pre-Loaded Modular Containers

San Gabriel, Calif.—New approach to an all-cargo aircraft wherein pre-loaded containers are slung under the craft's fuselage forming the lower body contour is being proposed by Hackney-Airlift Associates, Inc.

Although the idea of a detachable fuselage lower section is not new, having been demonstrated in the Fairchild XC-120 Pack Plane (AW Nov. 13, 1950, p. 22), the STAR-Lift System (Sea-Truck-Air-Rail) differs in that it utilizes modular containers of 10, 20, 30 or 40 ft. lengths called STAR-Tainers. These fasten flush to the bottom of the prime mover aircraft and form the bottom contour of the fuselage while at the same time adding to structural strength and rigidity. The forward fuselage section housing the crew compartment would be of a configuration permitting a standard nose wheel arrangement. A STAR-Fairing would be fitted immediately behind the crew compartment for drag reduction on deadhead missions without the STAR-Tainers or would be carried as a fairing aft of the last of the modular STAR-Tainers.

According to Hackney-Airlift, components of existing aircraft such as wing structure, forward fuselage sections, landing gears, empennage, etc., could be used and the idea is equally adaptable to turbojet, turbofan or turboprop swept-wing or straight-wing aircraft.

Such a prime mover aircraft is referred to as a STAR-Tractor and while the wings, fuselage, empennage and forward fuselage section are conventional, the fuselage aft of the crew compartment is replaced by a STAR-Frame, designed to support wings and tail surfaces. The fuel system would have the capability of carrying reserve fuel along the longitudinal axis of the STAR-Frame to permit weight to be transferred as desired providing the maximum flexibility of cargo load management within the CG range.

In a typical flight configuration on a jet-engine STAR-Tractor, five 20-ft. STAR-Tainers would carry a payload of 100,000 lb. The maximum taxi weight of the STAR-Lift cargo aircraft would be 273,000 lb. and operating weight empty would be 89,830 lb., the company said.

Delta Gains Extension On Jet Noise Protest

New York—Delta Air Lines has asked for and received from the Port of New York Authority an extension of time to answer the Port Authority's complaint filed last month seeking to enjoin Delta from violating noise rules at Idlewild. Delta now has until Dec. 31 to answer the court action.

C. E. Woolman, Delta president, said that the extension would "permit us to demonstrate that our operations out of New York International Airport will conform to the standards which you have set to achieve conditions tolerable to the people of the communities underlying the flight paths of our aircraft."

CAB Blames Accident On Missed Approach

Washington—Failure of an Allegheny Airlines pilot to complete a missed approach procedure was cited by the Civil Aeronautics Board last week as a probable cause of the crash of a Martin 202 Dec. 1, 1959, near Williamsport, Pa.

As a contributing factor, the Board indicated the probability that the aircraft's fluxgate compass was accidently caged by a crew member while the transport was in a right bank attitude. Intentionally duplicating this adjustment in the banking condition produced a compass error of up to 90 deg., which Board investigators say could have accounted for the aircraft's sharp departure from final approach and crash into Bald Eagle Mountain more than a mile south of the airport. The crew of three, an additional crew member, and 21 of 22 passengers were killed.

Capt. Thomas R. Goldsmith, 31, was in command of Flight 371, a regularly scheduled flight between Harrisburg and Williamsport, with copilot George M. Bowers, 32, and with an additional copilot, Donald W. Tygert, 26, occupying the jump seat.

Under weather conditions of scattered clouds with a 1,000 ft. ceiling and visibility of 1.5 mi. in light snow, the flight was observed over the airport at about 9:45 a.m. at an altitude too high to effect a landing, the accident report said. After this initial approach, the aircraft was observed to fly over the field and then make a right turn for a circling approach to Runway 27.

However, as the aircraft appeared to complete the turn, it was seen to roll out of a right turn and into a left turn and fly toward the south in level flight, finally disappearing into snow showers and clouds, according to the Board.

Board investigators came to the conclusion that because of the location of the caging switch between the pilots and at a low level, coupled with the lack of any guard for this switch, it was left exposed to accidental movement by any person occupying the jump seat.

With the resultant incorrect compass reading, Capt. Goldsmith probably was led to believe he had overshot his heading and immediately turned left to a new heading, the Board said in its report.

Immediately after learning of the possible effect of accidently caging the fluxgate compass, Allegheny installed guards on instruments in the four aircraft in its fleet which had similar switch installations.

Jet Engineer Fatigue Problem Reported

By Robert H. Cook

Washington—Crew fatigue is a mounting problem as the airlines shift to jet operations according to preliminary results of a Federal Aviation Agency study of flight engineers.

Basing their findings on extensive physical examination of 20 flight engineers, two physicians working under FAA contract have submitted a report indicating that mental and physical fatigue are a definite problem. They said it may be directly related to increased crew responsibilities, irregular flight schedules and increased flight duty time.

Study was made over a three month period on 20 engineers assigned to domestic and international turbojet transport flights. The doctors have recommended that FAA expand this type of study to include more engineers working under a greater variety of conditions.

Returns Analyzed

FAA is still analyzing answers from a questionnaire sent to a separate group of 188 engineers assigned to 69 piston-powered, 59 turboprop-powered and 60 turbojet transports. This fatigue questionnaire was prepared earlier this year in cooperation with the Flight Engineers International Assn.

Pilots and other crew members were not included in the survey because the initial fatigue complaints were filed by the FEIA, FAA said, but any results obtained could reasonably be expected to apply to all jet crew members.

Tests given the selected 20 engineers included a three hour physical at the beginning of the experiment, along with examinations started 90 min. after the engineers completed their post flight maintenance inspections. Scope of the tests included a personal medical history, laboratory tests, X-ray studies, electrocardiograms, complete blood counts, urinalysis and blood sugar tests, along with neurological psychometric studies to evaluate nervous tension and ability to think under stress.

Ten of the group flying international routes were examined by Dr. L. J. Stutman, of the New York University Medical Center in New York, and the balance assigned to domestic service were studied by Dr. Bruce V. Leamer in Los Angeles, Calif. Both physicians noted similar complaints from the engineers, who noted a great difference in fatigue between piston-engine and jet aircraft assignments. They complained that fatigue on jets became most noticeable after about two months.

Dr. Stutman reported that his group found they have been forced to spend more time on duty to log their customary 85 hr. monthly flight time, with the result that the engineers have found themselves spending less time at home and getting insufficient rest from previous flights. In addition, they complained that the jet's high speed and schedule flexibility has disrupted their sleeping habits because of constant flights through changing international time zones, and has also subjected them to health hazards as a result of trips which often traverse tropical and temperate zones within a matter of hours.

While electrocardiograms, X-rays and urinalysis tests on these men failed to disclose any physical damage, the doctor said, further tests on their cholesterol count and fatty deposits within the bloodstream indicated a "definite trend of stress unusual for men of their age."

Higher Cholesterol Levels

Noting a "marked and obvious difference" in the cholesterol level of the 10 flight engineers, compared with 10 average men of different occupations studied over a decade, Dr. Stutman reported the flight engineers' level tested out at 268 milligrams, or 20.2% higher than the normally expected 213 reading for men in the same age levels but different occupations.

Dr. Stutman also found that fatty deposits within the engineers' bloodstreams were considerably above normal, with a test reading of 555 milligrams. Compared with the usual level of 350-400 milligrams.

Analysis of the test information seemed to indicate a trend between fatigue and these blood studies, the doctor said, but actual proof of this theory would require a second physical study of flight engineers assigned to less fatiguing schedules for comparison purposes.

While Dr. Leamer said that he would not determine the medical cause for fatigue among the domestic service flight engineers in his group, he noted that their fatigue was "obviously due to increased tension resulting from irregular flight schedules and a lack of proper rest between flights."

As with the New York group, these engineers also complained of inability to regain their vigor after 2-3 months of jet duty and pointed out that they seemed more tired after 4 hr. of turbojet flying than they previously had on piston-engine aircraft flights of nine or more hours.

While none found fault with their monthly flight time limitations of 80-85 hr., Dr. Leamer said, they were unanimous in condemnation of schedules which they contend have forced them to spend as high as 275 hr. on duty

Economist Urges Aeroflot Mechanization

Moscow—A Russian transportation economist has charged that Soviet commercial aircraft designers and equipment manufacturers show no concern over Aeroflot's need for increased mechanization in loading and unloading operations.

Writing in the Economic Gazette, F. Shalimov said that the manufacturers' failure to reach agreement with Aeroflot on mechanizing ground services means that cargo, mail and baggage "quite frequently" must be placed on aircraft by hand. He cited this example of the "clearly abnormal" situation that prevails:

"Not long ago, an automatic conveyor was built and surpassed the boldest expectations during tests. It unloaded over a ton of baggage in one minute. However, estimates indicate that today this automatic conveyer can be used at only 10-15% of capacity.

"Fact of the matter is that the small baggage compartments in the planes, the arrangement of the hatches, and the lack of any mechanization inside the aircraft nullify the advantages of the new conveyer. It is for these same reasons the most progressive method of air shipping—by means of containers—still is not being employed."

Shalimov indicated that Aeroflot should have its own large design and manufacturing facilities "because other design bureaus and machine-building plants are too slow in planning and manufacturing needed mechanisms and apparatus."

He said that more than two years ago a Soviet plant tested a new cabin air conditioner "which was much more advanced than certain foreign models, including British-made ones." However, this air conditioner wasn't put into quantity production promptly, so that today it is obsolete in many respects and a new model must be designed.

The Soviet economist complained that design work on a new engine-handling crane has been "impermissibly slow." He called for quantity production of automatic lifts to load food containers and other passenger service items aboard Aeroflot transports.

a month to log their flight time. Piston aircraft duty, in comparison, usually permitted 3-4 days rest between flights, while present jet assignments seldom allow half this time for rest, the engineers complained.

Dr. Leamer noted that the duty time required for the engineers to earn their flight time on turbojet transports is approximately 100 hr. a month more than workers in other industries spend to collect their salaries.

FEIA officials say they would like to see this duty time dropped to no more than 180 hr. a month in order to bring their members' work schedules for jets more in balance with the flight time-duty time rating of piston engine schedules. As an example, they point out that on a piston-engine schedule from New York to Frankfurt, Germany, flight engineers can accumulate 30 hr. flight time in 72 hr. away from home. The same airline schedule with turbojets earns the engineer less than 17 hr. flight time for the same 72 hr. period.

Flight engineers examined by Dr. Leamer ranged from the age of 38 to 45 with average flight experience of 19.6 years, 1.3 years of it in turbojets. Before any definite conclusions are reached, the physician advised FAA, more tests should be undertaken with a younger age group which has transferred from piston engine to turbojet aircraft and with a second group having only jet experience.

Freedom to Compete With Trunks Asked for Supplemental Airlines

Washington – Greater competitive freedom between the supplemental airlines and trunk carriers is being urged by the Independent Airlines Assn. to counter the threat of a "socialized" air transport industry.

C. L. Burwell, IAA president, told a recent meeting of the Aviation/Space Writers Assn., that current Civil Aeronautics Board bidding rules for Military Air Transport Service contracts plus several Board-imposed operating restrictions on the supplementals, have raised a basic question of "whether or not the trunk carriers, and particularly the five or six who dominate the entire air transport industry, will be permitted by the Board to control the air transport industry."

Warning that continued domination of the industry by a few airlines could lead to its nationalization "into one gigantic BOAC or Aeroflot," Burwell said: "It seems apparent that if real competition and opportunity for new enterprises and new markets is to be stifled by a few big air carriers backed by the CAB, the air transport industry is being pushed and dragged toward socialization."

Supplementals' Effort

Burwell emphasized the supplementals' efforts to offer low cost air fares, and characterized the competition between trunk airlines as existing "mainly between advertising agencies, sales gimmicks and plush carpet treatment" under a system of administered fare prices.

"What the entire air transport industry needs is to abandon the intensive fight for one another's passengers and a concentration of energies on creating new markets from lower income groups in the dynamic America ahead," he said.

Crediting the supplementals with pioneering developments in air coach, air cargo, MATS and commercial charter business, Burwell said progress was achieved "in a hostile field, controlled then as now by the large, old route carriers."

Although a recent Supreme Court decision has had the effect of upholding the certification of the supplementals by CAB, new MATS bidding policies being applied by the Board pose a threat to the supplementals' future, he indicated.

Negotiated Bidding

Burwell warned that the 2.9 cents per passenger mile minimum rate floor established by CAB for negotiated bidding on MATS contracts could lead to the almost complete elimination of the supplementals of MATS business, as well as raising the taxpayers' cost for such airlift as much as $122,800,000 during the next year.

"It is, of course, obvious that with a rate floor, virtually all carriers will bid the floor," Burwell said, "and because of equipment preferences, the large flag carriers will secure virtually all of the business. Since the competition of the supplementals is removed, these carriers will no longer bid the rate floor and prices to MATS will skyrocket further.

"The large flag carriers do not really want to compete or negotiate for groups" he added, "but want to place the military traffic on individual tickets in their regular route flights as fill-up traffic at high commercial rates subject to relatively small military discounts. If this stage is reached with the aid of the CAB, the military becomes a prisoner of the large flag carriers."

Burwell estimated the minimum cost increase resulting from the new 2.9 cents floor would approximate $36 million annually for plane-load transportation as compared with the more than $122 million for individually ticketed passengers, which supplementals are now authorized to handle.

Airline Efforts

Efforts of some flag airlines to jointly negotiate with the military for a contract to carry military passengers at regular civilian fares were encouraged by CAB action protecting them against any possible anti-trust action, and amounted to giving the airlines a "bullet proof vest and increasing their leverage with the Department of Defense," Burwell charged.

One legal danger of the proposal, he said, was a provision calling for a two-year notice for cancellation by either the participating airlines or the military. Such a proviso could have the legal effect of obligating the government for a two-year period even though a new Administration might desire to terminate the contract, he said.

Outlining the growth needs of the supplemental airlines, Burwell took particular issue with CAB regulations limiting the carriers' charter flights to organizations that are limited in geographical scope and have memberships that have existed for a period longer than six months.

The restriction, originally intended to protect the trunks from the loss of individual passengers, is now obsolete because of the jet era, with its "colossal trunk carriers," and the restriction "represents an effort on the part of the government to force the traveler to travel as the government wants him to rather than as he desires," Burwell said.

In other areas, Burwell said the supplementals need some protection against the amount of surplus flight equipment assigned by trunk carriers to charter business. He suggested CAB regulations which would limit the large carriers' participation in this field. He also cited a need to expand the supplemental's operating authorities beyond their present limitations of 10 round trip flights a month for individually ticketed passengers.

United Jet Financing

United Air Lines is seeking registration with the Securities and Exchange Commission of a $25 million issue of convertible debentures through underwriters headed by Harriman Ripley & Co. (AW Oct. 31, p. 52).

Initially the borrowings will be used to retire current bank loans, but the long-term goal is to meet United's need for equity capital for financing its order for Boeing 720s, for the Capital Airlines merger, and possibly for a Boeing 727 order.

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CIVIC PLANNERS FIND NEW WAY TO ATTRACT TOURISTS

Civic and business leaders of Fort Walton Beach, Fla., find it pays to personally advertise their annual Pirate Spring Festival.

Before the Festival starts, these men visit 15 to 20 cities in the vicinity by chartered Southern Airways planes. They invite everyone they see to come on down and join in the fun.

Other community boosters find this same word-of-mouth method effective in bringing in new business and permanent residents.

* * *

INDUSTRIAL LOCATION NO LONGER DEPENDENT ON FIXED TRANSPORTATION

Thanks to flexible, dependable local airline service, it is now possible for almost any community to establish the transportation facilities needed to attract industry.

Take the area around the Great Lakes covered by Lake Central Airlines. Among the giant industries which have moved into this area are six Westinghouse plants, six RCA plants, and nine General Electric subsidiaries.

Because fixed costs are lower and living conditions more pleasant, industrial planners find these moves to less congested areas profitable, too.

* * *

FLIGHT FREQUENCY BRINGS NEW LIFE TO SMALLER CITIES

Local airline flights offer the businessman or all-day shopper "go-and-return" service between small cities and their metropolitan neighbors. Flights are scheduled to allow travelers to conduct a full day's business and be back home for dinner with the family.

For example, North Central Airlines schedules 53 daily flights between Milwaukee and Chicago; 20 between Detroit and Chicago; four daily nonstops between Duluth and Chicago; and 16 flights between Milwaukee and Green Bay, Wisconsin.

Progressive towns use this flight frequency to plan future growth and to attract new industrial development to the intermediate-size city.

* * *

HOW LOCAL AIRLINE AIDS COMMUNITY GROWTH

Frontier Airlines has drastically stepped-up its service to meet the growing needs of Farmington, N. M. – which has had a recent 500% population jump because of local discoveries of oil, gas, and uranium.

Twelve daily flights bring in everything from oil field rigging equipment to flowers. Cargo pits and doors have even been changed to accommodate over-size items.

Accommodating service like this is typical of local airlines everywhere. More than 300 cities now use local service airlines as their *only* means of air transport.

* * *

SPECIAL AIRLIFT BOOSTS CARNIVAL ATTENDANCE

Caribair airlifted nearly 6,000 sightseers to the 5-day St. Thomas Carnival in Puerto Rico this spring. 216 round-trip flights did the job. Nearly 90% were scheduled during the 3-day peak period.

Because local service airlines are uniquely equipped to transport rapidly a few dozen or several thousand people on short notice, conventions, meetings, and other special events can now be held almost anywhere.

* * *

LOCAL CARRIERS OFFER UNIQUE ADVANTAGES

Passenger volume on local service airlines has increased *five times* since 1950. The many unique advantages offered by these airlines are a big reason why. Here are just two!

Aloha Airlines has converted almost completely to Rolls-Royce powered F-27 high-wing Jetprops giving passengers an unmatched view of the scenic beauty of the Hawaiian Islands. Aloha's Jetprop fleet is supplemented by DC-3 "Vistaliners" with 5-foot "flight-seeing" windows, as well as special lens ports for undistorted photography.

To help passengers get around the big Southwest faster, Bonanza Airlines has now converted almost completely to pressurized, air-conditioned F-27 Silver Dart Jetprops.

Roster of Local Service Airlines

Alaska • Alaska Coastal • Allegheny • Aloha • Bonanza • Caribair • Central • Cordova • Ellis • Frontier • Lake Central • Mohawk • North Central • Northern Consolidated • Ozark • Pacific • Piedmont • Reeve Aleutian • Southern • Trans-Texas • West Coast • Wien Alaska.

Russians Criticize Aeroflot Operations

Washington—In one of the frankest criticisms of Aeroflot passenger service to come out of Soviet Russia, correspondents of Komsomolskaya Pravda have charged the government-owned carrier with "inexcusable" flight delays, inconvenient ground facilities and poor handling of passengers.

The correspondents wrote that they talked at Moscow's Vnukovo Airport with dozens of passengers who were traveling for pleasure, business, urgent mission or "by misfortune." They added, however, that all passengers were united in one respect—their dissatisfaction with Aeroflot's operation.

On the subject of delays, the writers admitted that the weather posed problems for an airline but added that "Aeroflot uses bad weather as an excuse to conceal its own sins, its organizational troubles and its inability to serve passengers solicitously and efficiently."

The report charged that in September only 57 planes out of every 100 that took off from Vnukovo left according to schedule.

Eighteen were delayed by weather conditions.

Delay Reports

Here are examples of reasons for other delays, according to a portfolio of 75 delay reports made available to the correspondents:

• **A Tu-104 turbojet transport** taxied away from the airport terminal one and a half hours behind schedule because of failure to load mail on time. Another Tu-104 flight was delayed for an hour and 12 min. due to an error made by the mail transport section. The local ramp group chief explained that "the Ministry of Communications is guilty. We have squawked about this. . . ."

• **A Tu-104 on the Alma-Ata route** was delayed 25 min. because the flight mechanic did not show up on time. An Il-14 (piston engine) Moscow-Zaporozhe flight was delayed 50 min. because the hostess overslept. "Personnel at the dormitory where crews rest simply forgot to awaken her," one of the correspondents wrote.

'Chain Reaction'

The writers noted that any delay causes a "chain reaction." Vnukovo Airport operates on a very tight schedule, they said, and "if you pass up your turn for taking off, you stand and wait until the takeoff runway is cleared. You sometimes have to wait 20-30 min."

They cited a shortage of electric power supply trucks, late loading of provisions and tardy maintenance inspections as other reasons for flight delays, and added that at Sheremetyevo, Moscow's second airport, there are even more delays on domestic flights.

"Putting it bluntly, the confusion and disorder here sometimes approach a record high," they concluded.

The writers had this to say about a laudatory article on the "world's shortest jet air route, which operates between Moscow and Leningrad:"

"We are not going to argue with the respected author of this article. The figures cited in it eloquently testify that air transportation between Moscow and Leningrad is necessary and economically advantageous. But, in our opinion, the author forgot to make one important elucidation. During the [18-month] period that this fast jet line has been in existence, only a little more than half of the flights were carried out strictly on schedule."

Low-Ceiling Flights

The correspondents said that on Oct. 7, for example, only two flights of a scheduled six were completed because of a low ceiling at Sheremetyevo, so that it was impossible to fly from Leningrad to Moscow. "And what about flying from Moscow to Leningrad?" they asked. "That was also impossible, because all planes serving the line are based at Leningrad."

The following day the group learned that Moscow's international airport, Vnukovo, had been opened and could have received any aircraft between 1100 and 1300 hr., if not all flights, but lack of reserve aircraft prohibited such substitute aircraft movement.

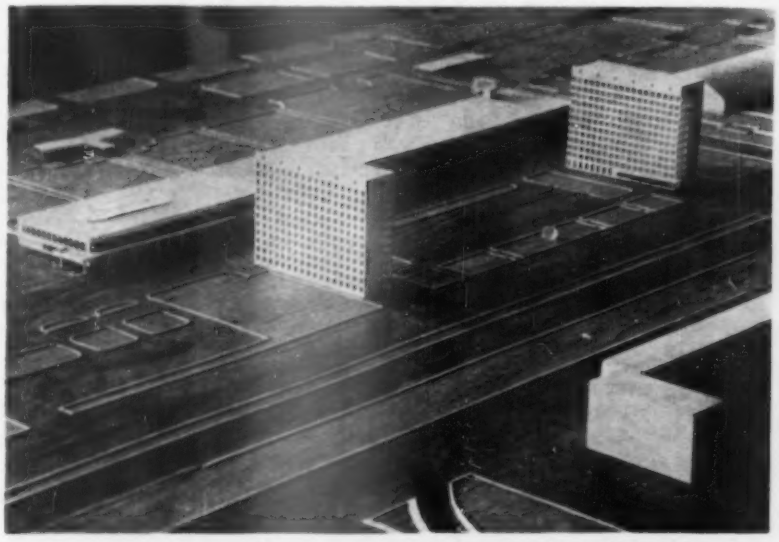
". . . Can it be considered normal when the capital city's airports even today are guided by Aeroflot Order No. 342 dated Aug. 19, 1958, according to which the Moscow air hub—the nation's largest—has in reserve only six aircraft: one Tu-104 and five Il-14s?" they questioned.

Insufficient Flights

They concluded that, while the Moscow Aviation Administration later added one Il-18 to the reserve, "this is clearly not enough. Two years have passed since Order No. 342 appeared. The number of Tu-104 flights has increased sharply. Now, 100-seat Il-18s and An-10s [turboprop transports] have appeared on the airways. But the aircraft reserve remains the same."

The average Aeroflot passenger was found to be patient and "amiable—even meek." He seldom resorts to the complaint book, of which four are maintained at Vnukovo Airport, one for each shift chief, they said. Even so, the lifetime of a 50-page complaint book is one and a half months, they reported. Here are examples of complaints passengers have entered in these books:

• **"Dear Uncles of Vnukovo Airport:** Imagine that there is foul weather. You are a 'mere passenger' and are waiting for your flight. There is no space in the hotel nor any vacant chair



Construction Starts on Moscow Air Terminal

Construction has started on a new downtown Moscow air terminal (AW Oct. 10, p. 38) which is designed to handle more than 50,000 passengers a day. Model shows layout of three main buildings, which will house ticket offices, a cinema, waiting rooms, restaurant and telegraph offices. Two central buildings will be 12-story structures; helicopter and bus service will connect with airports.

PROBLEMS? OR PROFITS?

Route pattern complexities of typical airlines demand a cargo aircraft with the capability of operating over both short and long route segments with excellent economy and earning ability. The Canadair Forty Four will do this for you! It combines the air cargo feeder liner with the long range aircraft to provide a standardized economic fleet unit. The Forty Four will give you profit-making operations, at current rates, over route segments as short as 200 miles and as long as 4,000 miles.

This is the type of flexibility that will answer the many and varied problems confronting airline operators who, because of the growing demands of shippers, are being forced to provide a combination of short, medium and long range air cargo services for the carriage of freight at attractive and competitive tariffs. In this situation, the Canadair Forty Four offers excellent economy and earning ability over the complete range of route structures that must be provided in the collection and distribution of air cargo.

Practical applications of this are found in the short route cargo services that are necessary in the supply and distribution of goods to or from the terminal points of transcontinental and trans-Atlantic services. This is evident between the major cities of the Eastern United States and between the principal points of Europe. These inter-city runs are essential extensions to the long haul trunk service, and with the Forty Four can be handled without a change of aircraft.

The need for this system of short, medium or long range operations will develop through the growing awareness among business establishments that the carriage of articles by air is becoming an essential element in the overall marketing function. This will open up new markets, new transportation requirements, new inter-city services. The Forty Four, with its flexibility of performance, can carry cargo at a profit over the whole distance spectrum—short, medium and long range, and has the airfield performance characteristics to get in and out of 85% of the world's major airports. THESE ARE DECISIVE ADVANTAGES IN FAVOR OF THE FORTY FOUR.

SOME RUNWAY AND PAYLOAD SPECIFICS ON THE FORTY FOUR-D4

1. From runways as short as 6,000 feet, can operate with 70% payload up to stage distances of 3,000 miles.
2. Can operate from 85% of the world's major airports, with due consideration to both runway length and allowable wheel loading.
3. Will earn an operating profit with load factors as low as 30%.
4. Breakeven load factors in the Forty Four represent loss loads on larger proposed equipment.
5. Breakeven load factors on larger proposed equipment represent major profit payloads on the Forty Four.
6. Can operate *non-stop* on the London-New York route with an average annual payload of over 55,000 lbs.

CANADAIR LIMITED, MONTREAL, CANADIAN SUBSIDIARY OF GENERAL DYNAMICS

in the waiting room. Excuse me, but I wish this sort of punishment upon you for your indifference."

• **"I am indignant to the depths** of my soul at the indifferent attitude toward passengers."

The writers point out that many passengers are sent by information bureau personnel to catch a plane at Vnukovo when it actually leaves from Sheremetyevo or Bykovo, a third Moscow airport which was to have been closed down 10 years ago but has seen a traffic increase in that period of 10 times thr volume handled in 1950.

They emphasize that there are accommodations for only 452 people at the hotels of three airports and that passengers spend as much time waiting for baggage as is spent on the trip from Kiev to Moscow.

They concluded that the "technology of the sky is not lagging" but added: ". . . A variety of ground problems, solution of which, as a rule, depends on Aeroflot itself, are holding back, like shackles, the headlong forward movements of this sky technology. These problems must be solved, and as soon as possible. Faultless service on the ground must be in keeping with the technical perfection in the sky."

Los Angeles Studies Future Airport Needs

Los Angeles—Comprehensive study of the future airport and aviation requirements for Los Angeles and the surrounding area has been started with Stanford Research Institute appointed to conduct a study of the information needed to determine the long-range facilities required.

Cost of the study may reach $200,000 and will be jointly supported by the Haynes Foundation and the Southern California Improvement Foundation. The study will cover a five-county area including, besides Los Angeles County, Orange, Riverside, San Bernardino and Ventura counties.

Purpose of privately financing the study by the two nonprofit foundations is to eliminate the possibility of special interest groups or private financial groups getting any special consideration in respect to airport placement. Scope of the survey will cover military, commercial, private and business aviation and information will be sought from commercial airlines, fixed-base operators, fleet operators and other sources. Stanford's preliminary study is scheduled to be completed in January, 1961.

Analysis of the preliminary study will make it possible to determine the major areas of further research required and the most effective course of action which the research sponsors might follow in subsequent research.

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When the timetable says "now," Sylvania Gold Brand Tubes are ready to take to the air. Gold Brand reliability contributes significantly to the dependable performance of avionics gear . . . reduces forced "layovers," helps keep airlines on schedule.

Sylvania Gold Brand Tubes are specifically designed to fill critical circuit requirements. Severe turbulence, high altitude, long demanding hours are routine for Gold Brand Tubes. Sylvania subjects them to tests more rigorous than performance requirements. For example: GB-5726, double diode detector, and GB-5727, thyratron, undergo shock tests of 850g, vibrational acceleration tests of 2.5g for 96 hours, multiple life tests of 100, 500, and 1,000 hours. They are designed to operate to 80,000 feet and at bulb temperatures to 165°C.

Gold Brand subminiature, miniature and small power type tubes are all available promptly from your Sylvania Industrial Tube Distributor. Try him. Ask, too, for your copy of the Sylvania Gold Brand Tubes brochure. Or, write Electronic Tubes Division, Sylvania Electric Products Inc., Dept. 1011, 1100 Main Street, Buffalo, New York.

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Airline Traffic—September, 1960

	Revenue Passengers	Revenue Passenger Miles (000)	Load Factor %	U. S. Mail Ton-Miles	Express Ton-Miles	Freight Ton-Miles	Total Revenue Ton-Miles	Over-all Revenue Load Factor, %
DOMESTIC TRUNK								
American	709,898	563,371	68.4	1,746,919	1,103,079	10,376,029	67,380,461	58.4
Braniff	189,351	92,495	61.2	445,937	145,139	563,740	10,027,979	49.0
Capital	311,153	125,788	56.8	554,608	329,121	537,878	13,489,159	52.2
Continental	116,575	77,029	49.3	216,213	136,906	538,992	8,278,051	40.2
Delta	277,188	144,403	55.5	499,723	357,947	1,835,484	16,125,479	47.4
Eastern	662,027	317,113	52.48	1,192,593	600,514	2,212,693	34,585,327	41.68
National	124,803	68,825	48.7	294,236	75,858	680,164	7,701,712	38.5
Northeast	123,148	40,501	48.4	116,275	42,101	221,232	4,255,759	42.5
Northwest	167,897	121,792	59.8	663,477	338,506	1,613,117	14,297,899	53.8
Trans World	438,369	411,244	67.4	1,553,688	886,956	4,067,099	45,947,308	53.9
United	716,069	516,009	68.6	3,097,251	1,092,098	7,073,326	60,771,979	59.1
Western	136,102	79,129	57.8	285,840	99,538	323,467	8,285,178	50.5
INTERNATIONAL								
American	8,314	8,387	53.9	8,424	556	317,213	1,193,779	50.4
Braniff	5,513	11,393	56.7	38,377	.....	132,374	1,386,567	50.8
Caribbean-Atlantic	27,006	1,877	59.1	1,847	.....	7,676	183,926	58.5
Delta	1,994	2,850	53.7	2,320	.....	19,350	332,820	52.0
Eastern	39,996	58,446	51.59	88,486	.....	228,044	5,762,538	49.16
Mackey	6,057	1,351	44.3	.....	96	4,456	150,109	48.4
National	2,635	2,140	63.7	1,533	.....	8,181	249,400	61.3
Northwest	17,686	33,909	49.6	1,297,302	14,536	1,079,595	6,005,624	53.6
Pan American								
Alaska	6,232	6,777	59.6	35,278	.....	187,017	930,262	61.2
Atlantic	162,955	228,440	65.7	2,181,433	.....	4,661,373	30,535,884	57.8
Latin America	90,531	112,440	64.1	421,849	.....	4,154,994	15,661,156	59.9
Pacific	42,127	155,706	70.8	2,123,963	.....	3,123,075	21,260,155	60.9
Panagra	10,259	16,732	55.7	86,340	.....	501,062	2,400,441	53.1
Resort[2]	.....	.....	.....	.....	.....	.....	.....	.....
Trans Caribbean[1]	.....	.....	.....	.....	.....	.....	.....	.....
Trans World	39,474	123,744	60.1	1,406,896	.....	1,729,723	15,884,155	58.6
United	17,422	43,298	67.9	276,967	9,925	181,575	4,857,669	64.9
Western	3,558	5,533	52.9	7,710	.....	21,724	605,521	55.2
LOCAL SERVICE								
Allegheny	67,362	13,663	46.7	24,499	38,532	57,188	1,424,859	48.2
Bonanza	21,604	5,296	38.6	6,921	4,830	10,228	529,234	39.7
Central	14,867	2,901	41.9	9,882	5,678	18,325	312,287	39.2
Frontier	29,820	8,124	41.8	25,983	11,571	66,903	889,263	46.1
Lake Central	20,719	3,338	41.9	6,128	23,492	.....	348,193	46.5
Mohawk	56,078	11,307	46.6	33,664	23,051	23,000	1,143,962	43.8
North Central	87,390	15,781	47.75	39,082	56,404	51,629	1,681,383	49.52
Ozark	54,256	9,435	43.7	18,198	32,996	38,080	993,261	48.1
Pacific[1]	.....	.....	.....	.....	.....	.....	.....	.....
Piedmont	42,137	8,838	48.4	13,736	16,169	28,343	906,677	50.1
Southern	20,914	3,765	29.7	15,175	11,226	15,502	403,351	31.8
Trans-Texas[2]	.....	.....	.....	.....	.....	.....	.....	.....
West Coast	34,224	8,342	48.18	14,253	5,185	24,929	841,011	48.58
HAWAIIAN								
Aloha	30,813	4,435	58.0	3,202	.....	6,666	365,511	47.4
Hawaiian	44,072	9,216	64.2	12,770	.....	184,312	988,096	62.8
CARGO LINES								
AAXICO[2]	.....	.....	.....	.....	.....	.....	.....	.....
Aerovias Sud Americana	.....	.....	.....	.....	.....	440,533	440,533	79.2
Flying Tiger	3,965	8,621	79.0	40,002	55,021	8,638,660	9,595,795	72.8
Riddle-Domestic	.....	.....	.....	17,084	34,658	2,993,797	3,045,539	67.6
Overseas	70	200	70.0	3,860	.....	370,934	394,852	64.4
Seaboard & Western[1]	.....	.....	.....	.....	.....	.....	.....	.....
Slick	1,122	3,797	100.0	.....	.....	3,528,153	3,907,804	100.0
HELICOPTER LINES								
Chicago Helicopter	29,253	485	49.9	1,254	.....	.....	47,578	41.7
Los Angeles Airways	3,339	116	54.0	4,937	2,516	.....	18,469	63.6
New York Airways	11,989	259	57.3	1,316	675	303	27,201	55.4
ALASKA LINES								
Alaska Airlines	12,058	10,146	55.8	73,707	4,599	450,348	1,533,177	64.7
Alaska Coastal	6,392	623	59.5	3,908	.....	5,234	72,689	60.4
Cordova	1,605	304	37.8	3,959	.....	45,687	80,775	49.0
Ellis	6,279	380	55.3	2,151	.....	3,036	43,934	64.0
Northern Consolidated	2,421	792	39.9	41,693	.....	78,573	207,897	61.3
Pacific Northern	11,969	11,147	52.3	124,449	10,570	412,950	1,761,178	67.2
Reeve Aleutian[1]	.....	.....	.....	.....	.....	.....	.....	.....
Western Alaska	617	36	72.0	862	.....	1,835	6,114	63.0
Wien Alaska	3,875	1,205	52.8	40,296	.....	97,613	261,513	57.0
Avalon Air Transport	10,177	362	62.1	526	.....	812	35,766	64.5

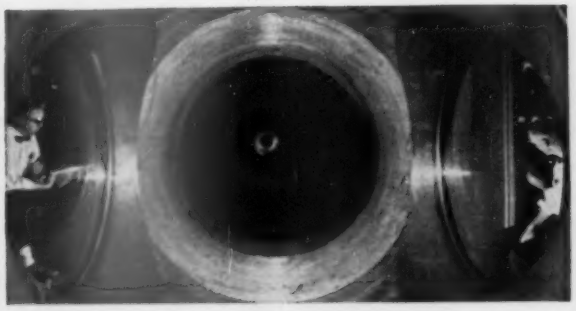
[1] Not available. [2] No operations this month. [3] Delays granted by the board as records destroyed by fire.
Compiled by Aviation Week from airline reports to the Civil Aeronautics Board.

BULLETIN FROM BOEING...

...WHERE CAPABILITY HAS MANY FACES

Minuteman, the nation's first solid-fuel ICBM, blasts from underground silo, left, in tethered firing test. Successful Minuteman firings cut test program, saving millions of defense dollars. Boeing is weapon-system integrator of the 6000-mile-range Minuteman missile, now under development.

FLYING COUSINS. You can cross a continent or an ocean in brief hours by Boeing jetliner, then fly to local airport or center-city in a helicopter built by Boeing's Vertol Division. Vertol helicopters are flown by the U.S. Air Force, Army and Navy as well as by the commercial carriers and armed services in many countries. Boeing 707s and 720s—most proved jetliners in the world—have already carried more than 10,000,000 passengers.



HOTSHOT TUNNEL. Here, in largest privately owned wind tunnel facilities in the world, future aircraft, missile and space-vehicle models can be tested at speeds up to 18,000 miles an hour. Many space-flight conditions can be simulated during tests. Decades of emphasis on research have enabled Boeing to pioneer nation-benefiting advances in vital areas of manned and unmanned flight.

SEAGOING TURBINES. Boeing gas-turbine engines power this high-speed oil company personnel boat as well as U.S. Navy minesweeping launches and landing craft. Light, powerful, compact Boeing shaft-drive turbines have scored many firsts: first turbine to power highway truck, fire engine, helicopter, locomotive and light airplane. Boeing turbines also serve in jet-engine starters used by U.S. Air Force and commercial airlines.

BOEING

JET AIRCRAFT, MISSILES, HELICOPTERS, TURBINES, WEAPON-SYSTEM MANAGEMENT, SPACE-FLIGHT VEHICLES AND SYSTEMS.

AIRLINE OBSERVER

► United Research study on international civil aviation policy (AW June 13, p. 38) was scheduled to be delivered to the White House late last week.

► **French government has stepped into the dispute between airlines and jet air crews over working hours. Government has ruled jet flying time for crews should average 75 hr. monthly. In addition, crews on long jet flights are required to have at least four consecutive days off each month. Crews were balking against airline attempt to keep them working on jets more or less at the same pace as on piston aircraft.**

► Air Line Stewards and Stewardesses Assn. attempt to drop its affiliation with the Air Line Pilots Assn. is being blocked by the AFL-CIO, which feels the inter-union argument should be settled internally. ALSSA has failed to get an independent charter, and AFL-CIO President George Meany has asked the pilots' union to drop a suit filed against the stewards' union after ALSSA moved from ALPA headquarters. As a result of Meany's personal intervention, ALSSA and ALPA officials met in Washington recently to discuss their differences.

► **Federal Aviation Agency has intensified its bird control program at Washington National Airport. Control tower operators, operations officers and airport police are under orders to maintain strict vigilance for unusual bird or wildlife activity at all times. Advisory information on bird activity will be issued to pilots, and police cars will be dispatched to areas of heavy bird concentration where siren blasts will be used to disperse flocks. Shotgun noise also will be used to scatter birds without injuring them. Consultation with Fish and Wildlife Service experts, Smithsonian Institution officials and Audubon Society members will be held to determine other means of controlling bird flights at airports.**

► Trans World Airlines' experimental use of Edo Loran and doppler navigation aids is drawing heavy fire from the Transport Workers Union, which fears use of the equipment may lead to eventual displacement of TWA navigators. Union spokesmen complain that installation of the units on the control panel of one TWA Boeing 707, instead of at the navigator's station, has resulted in the copilot taking over strictly navigational duties on transatlantic flights.

► **Federal Aviation Agency has issued an order specifying that contracts negotiated by the agency in which FAA supplies part or all of the funds must include a provision under which a fair share of the rights to data and patents will be retained by the government. Share is to be in reasonable proportion to the respective contributions of the agency and the contractor.**

► Number of travelers leaving United Kingdom by air exceeded those traveling by sea for the first time during the first six months of 1960.

► **Pan American World Airways still is interested in a larger, turbofan-powered Boeing 707 though it has failed to go ahead on a version designated the 707-520. This airplane would have a longer fuselage and an increased thrust version of the Pratt & Whitney JT3D turbofan engine. Price is reported as a stumbling block.**

► Export-Import Bank of Washington has extended a $3.4 million credit to TAI, independent French airline, toward the purchase of one Douglas DC-8 turbojet transport. Total cost of the airplane is $6.8 million, including equipment and engine spares. TAI will pay about 41% of the cost in advance, with Douglas Aircraft Co. financing the balance of $600,000. French American Banking Corp. of New York will participate in the Eximbank credit to the extent of buying early maturities in the amount of $727,000.

► **Watch for a move by El Al Israel Airlines to expand its routes into Africa. Israeli government delegation is now conducting talks on possibilities of negotiating bilateral air transport agreements with Ghana, Liberia, Nigeria, Mali and Senegal.**

SHORTLINES

► **British European Airways** is planning to start service to Budapest Apr. 1, 1961, following agreements reached by the British and Hungarian governments. BEA will serve the Hungarian capital twice weekly by extending its London-Prague flight Monday and Thursday. Vickers Viscount 806s will be used.

► **British Overseas Airways Corp.** is using de Havilland Comet 4s removed from transatlantic service for its London service to the Far East and Australia. The British carrier has increased its London Singapore service from two to three flights weekly and London-Australia service from 10 to 12 flights weekly. BOAC has begun weekly London-Karachi service with the Comet 4 and is operating a twice weekly service from London to the Persian Gulf with Comet 4s for its associated airline, Middle East Airlines.

► **Civil Aeronautics Board** has granted permission to Eagle Airways (Bermuda), Ltd., and Eagle Airways (Bahamas), Ltd., to operate jointly under the name Cunard Eagle Airways. Cunard Steam Ship Co. recently acquired control of Eagle and wants the carriers to operate with the Cunard name.

► **Federal Aviation Agency** will retain L. W. Burton as director of Washington National Airport. Burton, on leave of absence for the past few weeks, had been acting director of the Bureau of National Capital Airports as well as director of Washington National until the appointment of G. Ward Hobbs as director of the bureau.

► **Northwest Airlines** has begun daily transpacific flights with Douglas DC-7C aircraft to fill the gap in service caused by a strike of flight engineers, belonging to the International Assn. of Machinists, which has grounded Northwest's fleet of Douglas DC-8 turbojet transports. The airline formerly operated four DC-8 round trips weekly and three DC-7C round trips weekly between the U. S. and Far East.

► **Trans World Airlines** has started three new all-cargo flights this month using converted Lockheed L-1649 aircraft. TWA began two new weekly New York-Shannon-London-Frankfurt flights Nov. 1, making a total of five flights weekly. A new daily New York-Los Angeles-San Francisco flight was scheduled for Nov. 10. In addition, TWA was scheduled to begin daily service from Philadelphia to New York, Chicago and Los Angeles Nov. 10.

Could you pick the guilty part?

Professional crime-busters say there's no such thing as "looking like a criminal." And it's much the same with replacement parts. A bargain-price substitute often resembles the original so closely that even a master sleuth would be hard put to find a single clue to prove the difference. But it doesn't take your engine long to detect any hidden weakness. And right then, instead of saving money, you may face charges for costly major repairs.

The best solution is always to specify original equipment parts for your Pratt & Whitney Aircraft engines. You can count on their quality. It's assured by precision processing and rigid quality controls. Through research, refining and testing, they are constantly improved to match the requirements of improved engine performance. Without access to these improvements, no substitute is likely to measure up to the high standards of dependability engineered into Pratt & Whitney Aircraft engines.

Original equipment parts are quickly available direct from Pratt & Whitney Aircraft or from its authorized distributors in the United States and Canada.

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East Hartford, Connecticut

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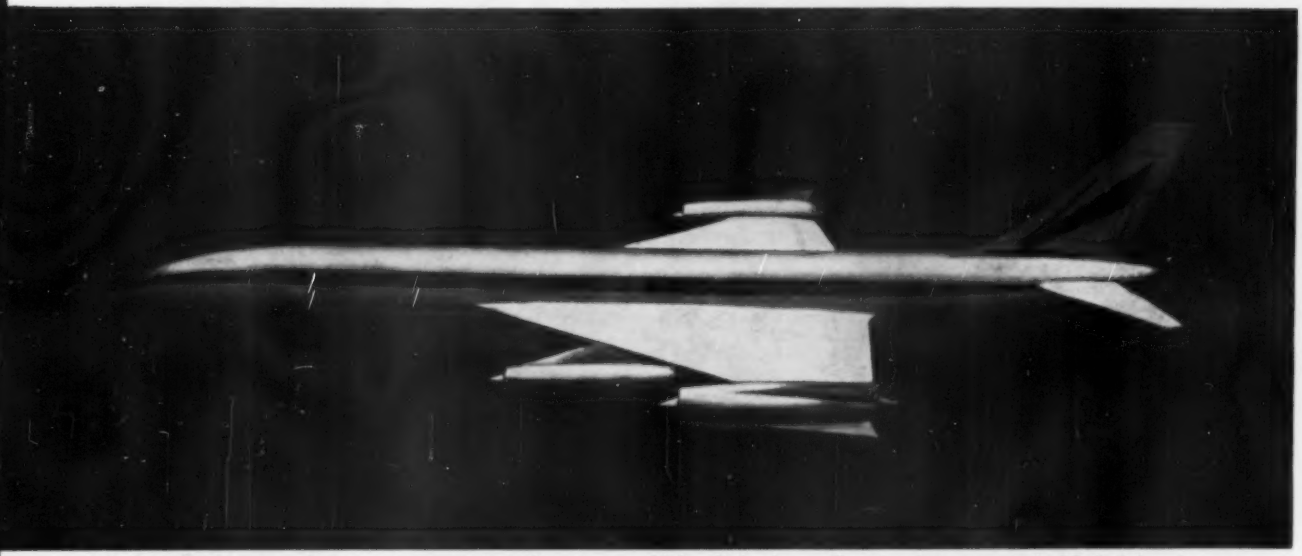


CONVAIR 58-9 proposed supersonic transport configuration would be all-aluminum alloy aircraft to operate in Mach 2.4 cruise range. Capacity would be 52 passengers and range would be on the order of 2,500 naut. mi. with reserves.

B-58A Proposed for Transport Research

National research program based on the B-58A bomber and aimed at establishing design requirements for operational and salable supersonic transports is being proposed by Convair Division of General Dynamics Corp.

Major advantage of the program at a national level is to fill the time gap between now and 1965 when the North American B-70 begins to accumulate Mach 3 flight hours. Convair's program would parallel the B-70 project and would be expected to produce data supplementing that coming from the B-70 flights.

Advantage to Convair is that the company can exploit and extrapolate its current limited B-58 flight experience at Mach 2 to strengthen its competitive position in the race to a Mach 3 transport, the agreed goal of the majority of American entrants now in the running.

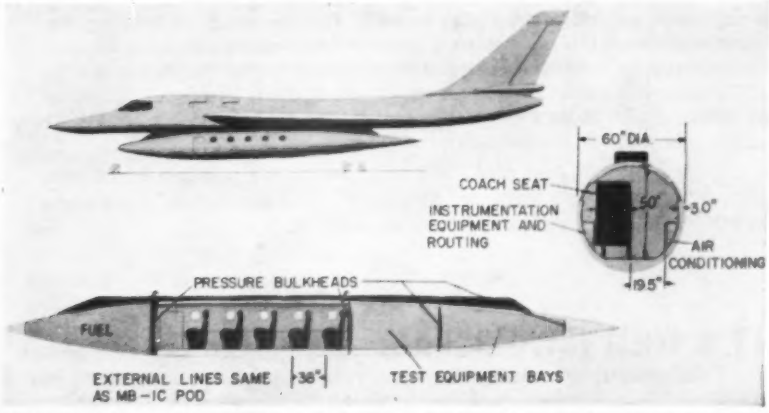
Three-Step Program

Convair's program aims at the easiest, fastest and cheapest way to get operational experience with an airplane simulating a supersonic transport. It starts with the B-58A Hustler, currently the only available plane capable of sustained supersonic flight at Mach numbers above 1.5, and builds this three-step program:

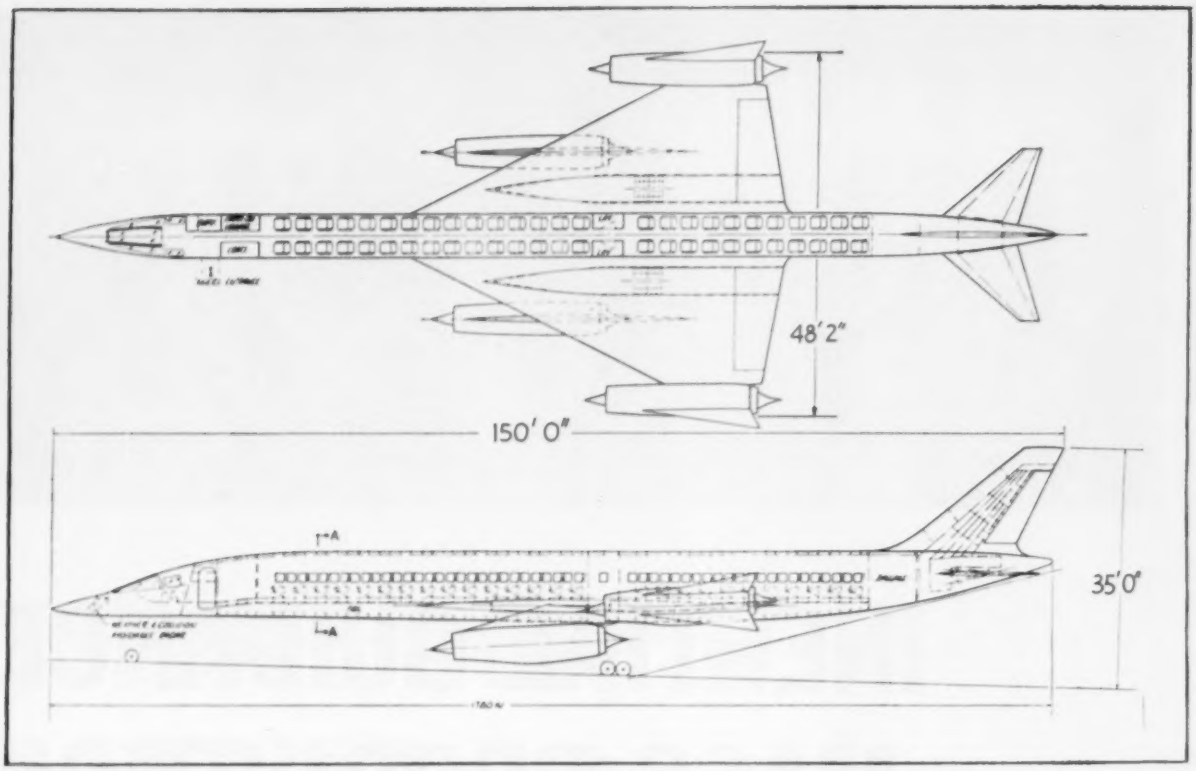
• **Existing B-58A** would fly simulated or actual airline routes at supersonic speeds, working in the range from Mach 1.5 to 2.0. This phase of the program would provide an engineering and operational foundation for solutions of numbers of problems, including such current unknowns as airport operations on the ground and in the pattern, airways traffic control, sonic booms and handling characteristics consistent with passenger-carrying operations. Part of this step is already scheduled by National Aeronautics and Space Administration for next year. Using a B-58 operating out of Edwards AFB, NASA pilots and technicians will investigate the handling characteristics of the plane in simulated commercial use. They will study all flight phases from takeoff through landing, with side explorations into en route problems of ATC, navigation, reserves and alternates.

• **"People-pod"** with room for five passengers and test instrumentation would be carried by the B-58A as the second phase of the program. Purpose would be to explore the subjective reactions of passengers in the unusual environment of a supersonic transport cabin. One example: Pulling back power abruptly at Mach 2 cruise produces a 0.7g deceleration, far above the level produced by the most severe current combination of braking and thrust reversing. Convair says such a modified B-58A could fly early in 1962, and would account for about $2 million program cost.

• **B-58 transport,** model configuration 58-9, would be designed and built in a test quantity of a dozen. This design,



PEOPLE POD for existing B-58A Hustler bomber would enable researchers to obtain human factors data on passengers during supersonic flight.



MODEL 58-9 two-view shows basic aerodynamic geometry of Convair B-58C strateric bomber proposal, modified to make the layout suitable for a supersonic transport. Horizontal tail has been added and fuselage redesigned and extended for cabin space.

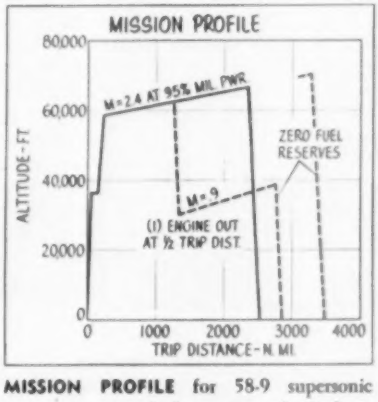
drawing on the work already done by the company in proposing a B-58C supersonic-mission version to Strategic Air Command, would be powered by four Pratt & Whitney J58 turbojets rated at 30,000 lb. thrust each without afterburning. The 58-9 would carry 52 passengers in a conventional fuselage replacing the bomber fuselage of the B-58C. Operational speed range would be Mach 2.4. The airplane would be all-alumi um structure, as opposed to the stainless-steel makeup of the B-70. Convair program dates call for a first flight late in 1963 and a total cost of about $200 million for design, development, construction and testing of the 12 airplanes.

This last step, according to Convair engineers, would provide the final lots of data needed to determine the real requirements for a supersonic transport. With a dozen such aircraft flying in and out of commercial fields and operating on the world's airways, the key airline parameters of utilization, economy, maintenance and operational experience could be pinned down easily and in a short over-all time cycle that would meet the requirements of a 1970 commercial airline.

Aerodynamic layout of the 58-9 transport proposal is drawn from the B-58C using that plane's delta wing, general powerplant arrangement, and vertical tail. But a long passenger-carrying fuselage replaces the short bomber fuselage, and a horizontal tail is added to make the stability and control problems more easily solvable.

The B-58C started life as a proposed all-supersonic-mission bomber built around the Pratt & Whitney J58 engine (AW Apr. 18, p. 64). It incorporated a few changes in detail layout, including a slightly different powerplant package installation.

Convair engineers started with this design and modified it to meet their studied requirements for a supersonic transport. These requirements were developed by computer techniques which used basic aerodynamic data to develop performance for a family of aircraft meeting wide ranges of speed and route performance. These "paper" airplanes were continuously cycled through the computer to produce a series of optimum aircraft for any given set of requirements. Nobody believes that the 58-9 is the optimum supersonic transport, but some do believe that it is the best supersonic transport that could become available in a short time span.



MISSION PROFILE for 58-9 supersonic transport proposal shows stepped climb to initial cruise altitude just under 60,000 ft. and progressive increase in altitude due to fuel burn-off. Cruise speed would be Mach 2.4 at 95% military power. Reserves are included in profile.

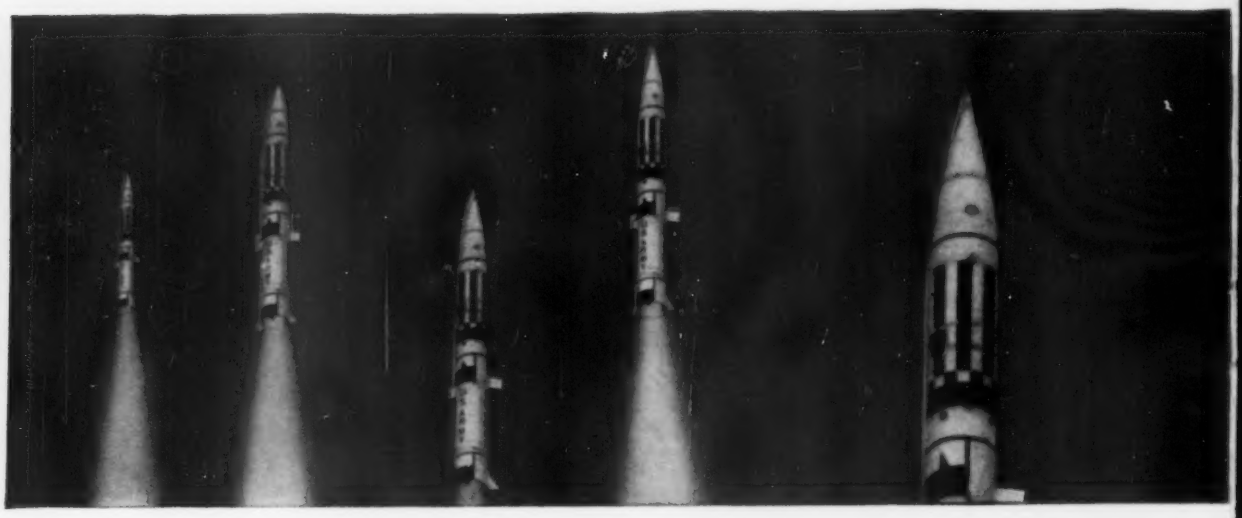
Cabin Interior

Cabin interior of the 58-9 features two rows of single seats of the type used in the Convair 880 and 600 transports. Seats are on a 38-in. pitch, and the aisle width is 18 in. between armrests. Total capacity of the cabin is 52 passengers.

Basic performance calculations show a Mach 2.4- cruise speed (1,376 kt.) and a 2,525-mi. range.

Block speed for the route is 1,038 kt. Time for the trip figures to be 2.43 hr. Reserve range at the terminal is 955 naut. mi.

At a takeoff weight of 190,000 lb., the 58-9 would require a field length of 6,500 ft., and would lift off the runway at 199 kt. Landing would take a balanced field length of 8,700 ft. at a



INERTIAL GUIDANCE MASS PRODUCTION

Unified facilities turn out stable platforms in volume for Pershing, cut lead time 20%—also offer advanced inertial guidance experience in design and engineering

Knowmanship in Action

Inertial guidance capabilities at E-P extend across three fronts—design, engineering, and production. Our production efficiency is proved by the fact that we are now mass-producing complete inertial guidance systems, including highly-precise air-bearing gyros—"heart" of inertial guidance—for Pershing. We are able to do this, and save 20% in normal lead time, because of advanced techniques, and most modern facilities, coupled with most efficient management.

We have developed space-age techniques that enable us to machine such a difficult material as beryllium to tolerances as fine as 10-millionths of an inch. Our specially-developed "super-clean room" maintains perfect conditions for assembly, test, and calibration of delicate inertial guidance components on a *volume* basis.

E-P KNOWMANSHIP also offers practical advantages in inertial guidance design and engineering. We have a technical staff of over 500 devoted exclusively to solving inertial guidance problems. Our engineering experience includes work with air-bearing gyros that float both gimbal and spinning mass, as well as with liquid-floated gyros and accelerometers. Gimbaling specialists have developed the way to more compact inertial guidance platform packaging.

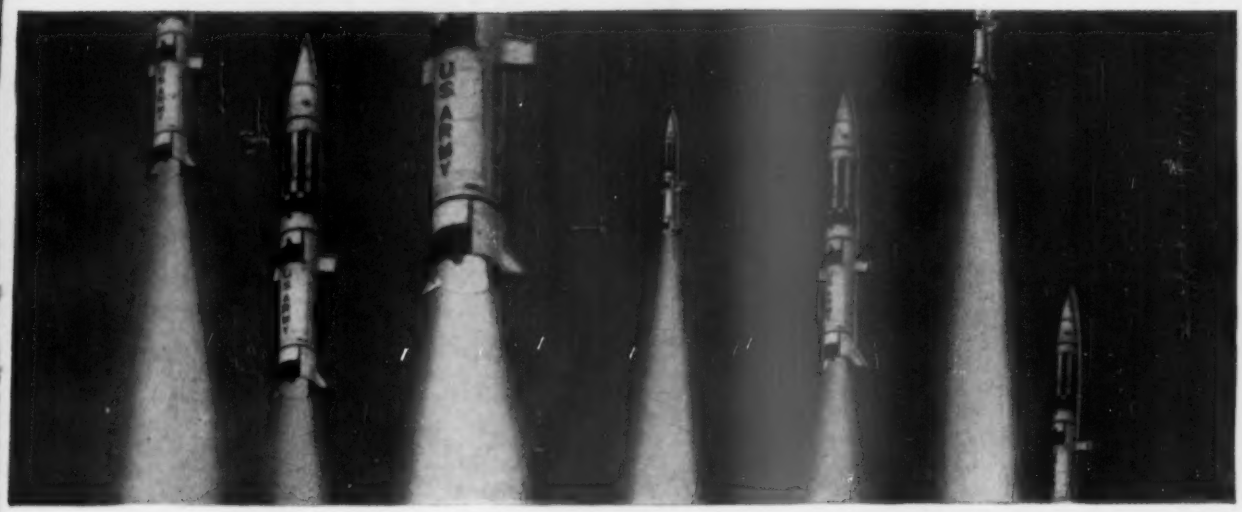
The point is this. With demonstrated production accomplishments—plus practical design and engineering experience—we offer a rare degree of proficiency to apply to *your* inertial guidance needs—whether they be for outer space or under the sea. Why not explore our capabilities! A word from you will bring our complete story to your desk.

TECHNICAL KNOWLEDGE + EXPERIENCED MANAGEMENT + SPECIALIZED CRAFTSMANSHIP = **KNOWMANSHIP**

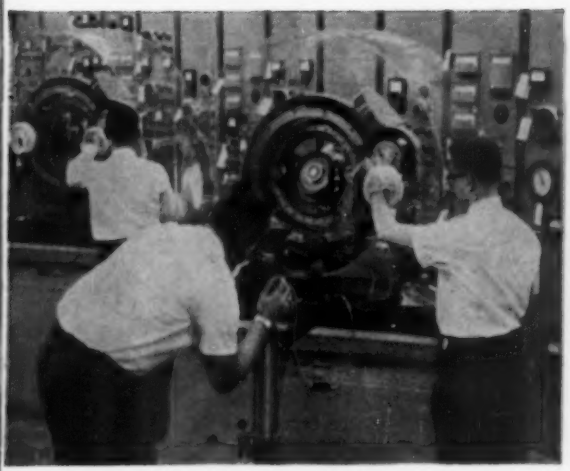
Eclipse-Pioneer Division

TETERBORO, N. J.

THE Bendix CORPORATION



SYSTEMS NOW IN AT BENDIX E-P



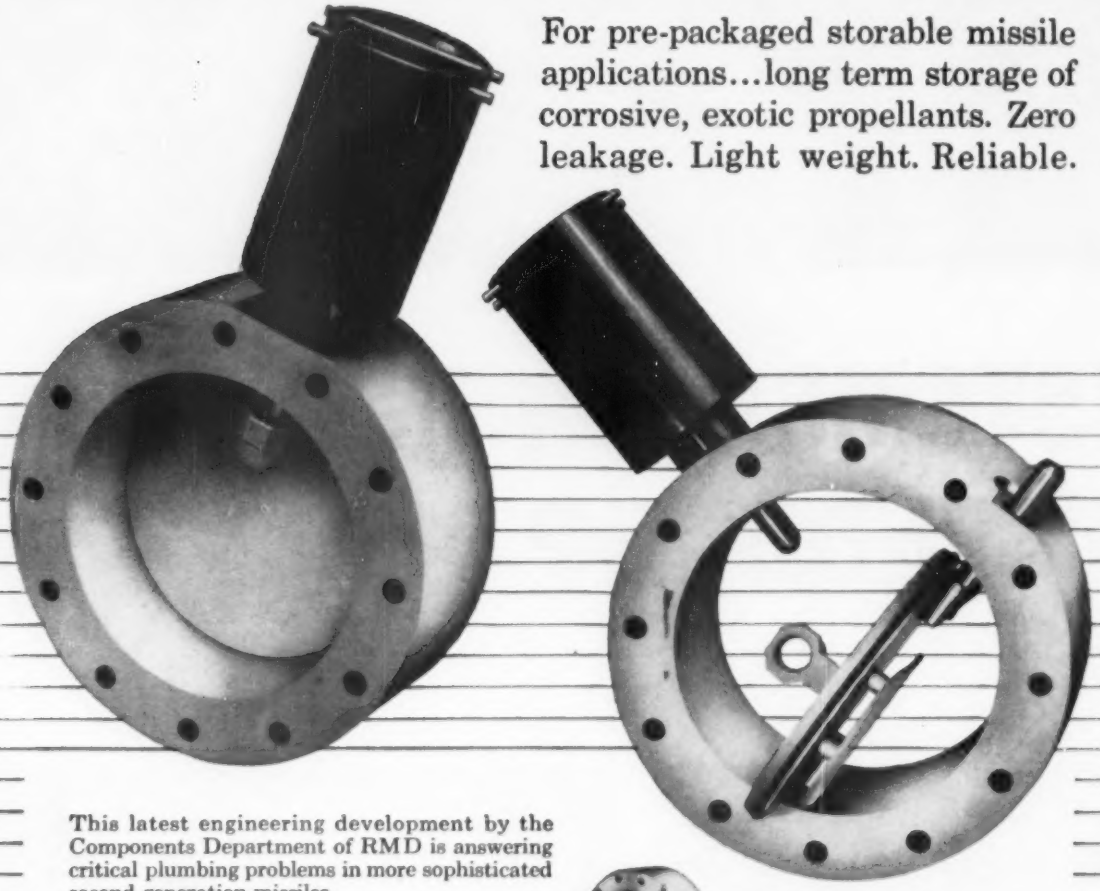
SUPERFINE TEST AND CALIBRATION. E-P checkout facilities include: Single axis and planetary sidereal test stands accurate to .005° per hour; indexing heads with an accuracy of ± 2 seconds of arc used for calibrating pendulous integrating gyros.

"WORLD'S CLEANEST ROOM" at E-P offers perfect conditions for mass assembly of precise components. In this 55-station, air-conditioned area, all contaminants larger than 0.3 micron (.000012") are filtered out.

New! From the Reaction Motors Division of THIOKOL

HERMETIC BARRIER VALVES

For pre-packaged storable missile applications...long term storage of corrosive, exotic propellants. Zero leakage. Light weight. Reliable.



This latest engineering development by the Components Department of RMD is answering critical plumbing problems in more sophisticated second generation missiles.

Hermetic barrier valves combine metallic sealing capabilities of burst disc with low pressure drop of butterfly valves. They are designed for use with storable propellants—cryogenics such as hydrogen, fluorine and other hard-to-handle fluids.

Propellant pressure actuates these valves which are flow driven to full open position. Squib powered and solenoid-triggered types are also available. Sizes 1½" to 10". Reclosure handled manually or remote with elastomeric seal. Hermetic butterfly eliminates all chance of free particles entering propellant stream.

For full information, contact Sales Manager, Components Dept.

Squib, or pneumatic actuated hermetic butterfly valve.

BREAKAWAY TYPE DISCONNECT VALVE. External leakage of propellant prevented by hermetic seal when connected. Zero leakage after disconnect. (In ½" to 8" sizes.)

Thiokol®
CHEMICAL CORPORATION
Reaction Motors Division
Denville, New Jersey

touchdown speed of 148 kt. and landing weight of 110,420 lb.

Convair cost estimates show the 58-9 could be flown with a direct operating cost (DOC) of 2.5 cents per seat mi. This multiplies out to $2,060 per supersonic flight hour.

Program Timing

The Convair program for the 58-9 configuration assumes that the order to go ahead will be given for January, 1961. First flight would be 33 months later in October, 1963. First four airplanes would be put through a company flight test program lasting 18 months, while FAA, NASA and DOD would evaluate their airplanes for a 15-month period.

Simulated commercial operations would begin in early 1965 with a MATS squadron doing the operational shakedown, and by October that year, the 12 airplanes in the program would have accumulated 2,500 total hours of supersonic operational time.

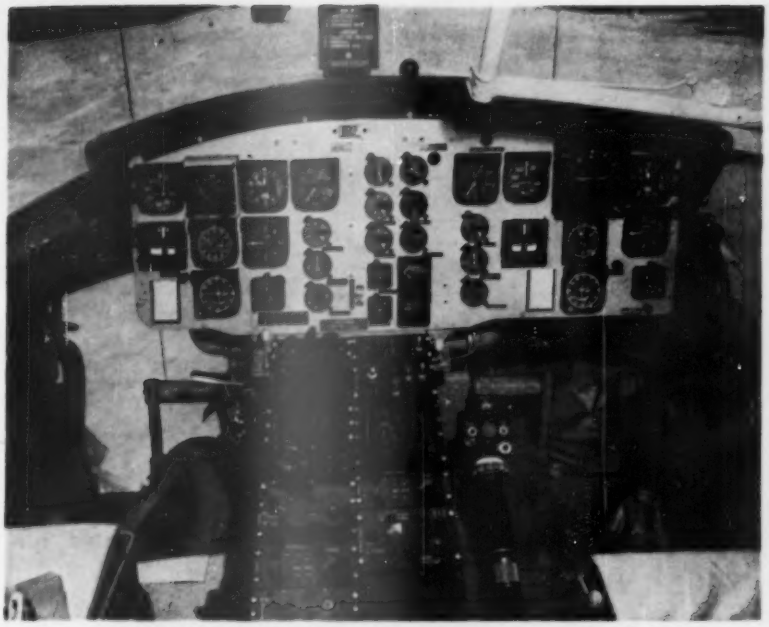
Initial rate of spending called for is $23.5 million the first year, increasing to $59 million the second and $67.5 million the third, during the years of intensive engineering design and development, and production build-up. Fourth-year spending would decrease to $45.5 million as production and test continued in parallel, and by the fifth year the program cost would be down to that required to support the airplanes in their operational role. That figure is currently estimated as $3.72 million.

Program Benefits

Convair argues that everybody in the business would benefit from the over-all program, just as in earlier national programs. The company cites the joint NACA-Dept. of Defense projects that produced the "X" series of research aircraft to benefit industry across the board, and the turboprop shakedown operations conducted by Military Air Transport Service's 1,700th Test Squadron (Turboprop) which fed a fast 10,000 hr. of flight time with relatively unproven powerplants into the general hopper of operational experience for everybody to use.

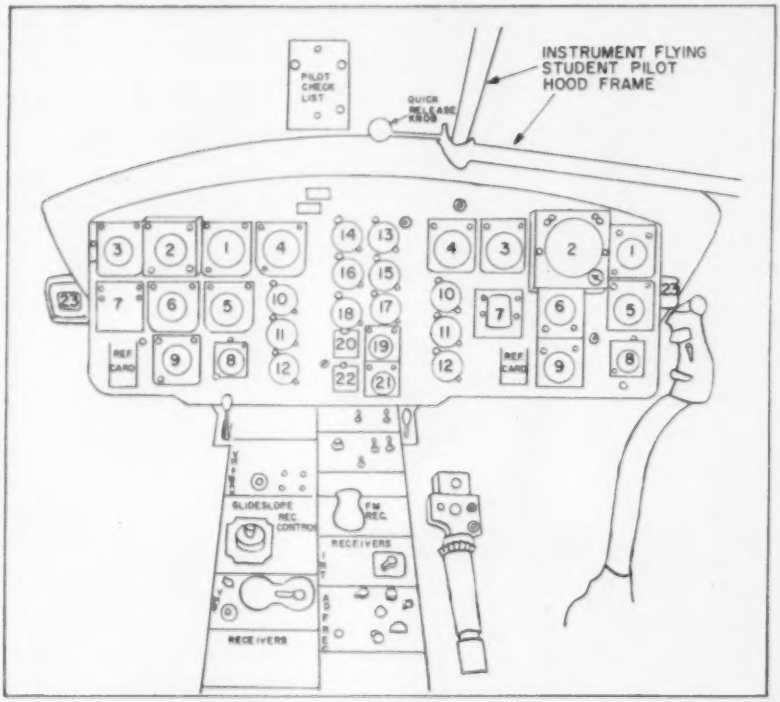
Parallel benefits to industry, the airlines and military and civilian agencies would be produced by the program, the company says. For industry, the airplane could serve as a powerplant testbed for a variety of engines, producing supersonic cruise data for engines without afterburning. It could provide strength and materials data under conditions of heat-soaked structure, and answer a myriad of questions in the design of ancillary systems operating under extreme temperature conditions.

For the airlines, Convair's program would provide the answers to most of the operational questions before the carriers had to commit themselves to



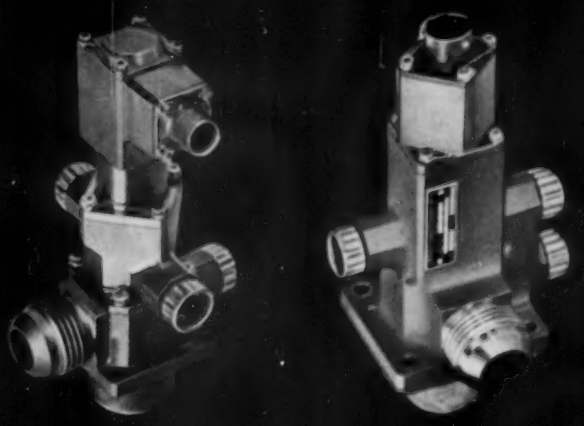
Bell HU-1A Helicopter Instrumentation

Cockpit details of the Bell HU-1A Iroquois helicopter, selected by U. S. Army as its new instrument trainer (AW Oct. 17, p. 34), are outlined in this photo and drawing. Instrument student rides on right side and has radio controls at his left hand. Army has purchased 14 of the trainers for delivery to the Army Aviation School, Ft. Rucker, Ala.



Instrumentation includes (1) altimeter (2) attitude indicator (3) airspeed indicator (4) dual tachometer (5) rate of climb (6) radio magnetic indicator (7) turn and bank indicator (8) clock (9) course indicator (10) torque meter (11) per cent tachometer (12) exhaust temperature (13) fuel gage (14) fuel pressure (15) engine oil temperature (16) oil pressure (17) transmission oil temperature (18) transmission oil pressure (19) d.c. voltmeter (20) load meter, main generator a.c. voltmeter (22) load meter, standby generator (23) standby compass. Quick release knob clears instrument hood from windshield.

THRUST VECTOR CONTROL BY LIQUID INJECTION



from MOOG:

Use of enriched propellants, with consequent high gas stream temperatures, has emphasized the reliability, performance, and weight advantages of secondary injection thrust vector control. Moog has developed liquid secondary injection control with outstanding momentum recovery, stream concentration and penetration characteristics. The experience gained in the design, manufacture and test of these systems constitutes a unique competency.

MOOG SERVOCONTROLS, INC. PRONER AIRPORT, EAST AURORA, NEW YORK

LEADING INNOVATOR AND PRODUCER OF ELECTROHYDRAULIC SERVOVALVES

finding out the hard way through the introduction of new equipment.

For the military, there would be technical benefits to add to background knowledge for supersonic aircraft design.

For the Federal Aviation Agency, the Convair program would help solidify thinking and theory into firm requirements for supersonic flight standards.

Convair wants such a program to be jointly sponsored by three of the agencies to derive benefits from it: FAA, NASA, and the Air Force.

Admittedly all the aims of this program are not altruistic. Convair's Ft. Worth plant will run down on B-58 production, and the company's experience so far with the Model 880 and 600 follow-on, plus its uncertainty over the Model 60, leaves it in too precarious a position to tackle a supersonic transport project on its own.

Spokesmen for other segments of the American transport aircraft industry agree that no company is in a position to tackle alone the entire job of design and development of a supersonic transport. They feel the world market is too small and the necessary price tag to the airlines too high even if the entire market were cornered by a single company.

Cooperative Development

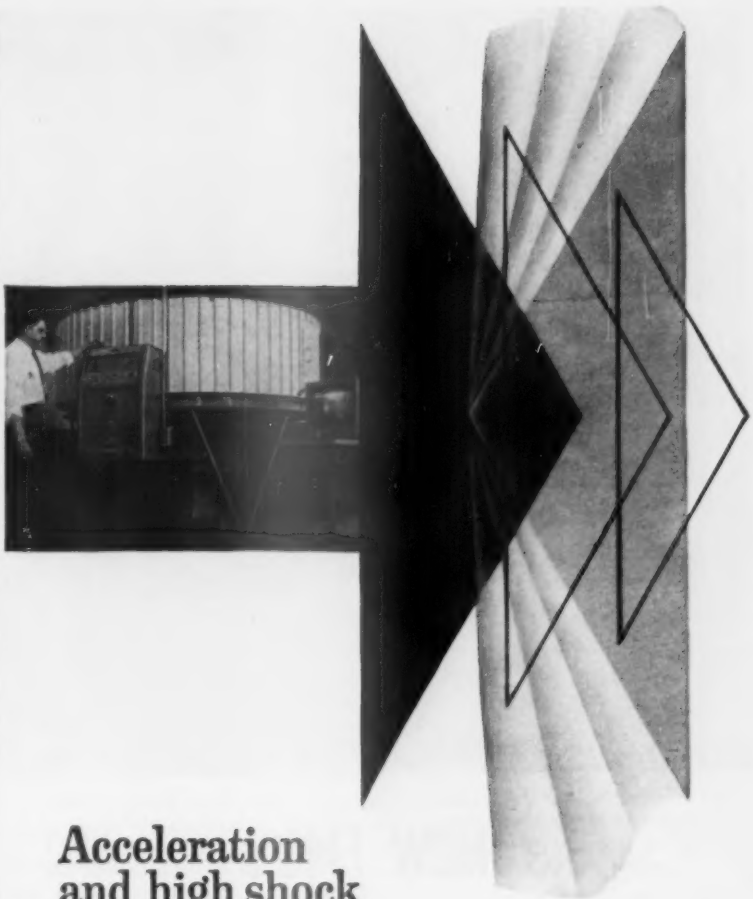
Cooperative development is one proposed method now being tried in both England and France. But observers doubt that any combine of U. S. companies would cooperate on a joint commercial airliner.

Lacking that, the only method seems to be an outright subsidy for development, either in the form of an order for a specific number from the military, or in the form of the kind of proposal presented by Convair.

Any company would hope for both to happen, but with the military still negotiating for subsonic jets and apparently not eager to commit too much of its money for transport anyway, any specific order from that quarter seems far off.

Even if Convair gets this program through, it will still find itself entering 1966 with a batch of data and flight experience on a Mach 2.4 transport which, by its own admission and general agreement among competitors, is the wrong speed for a supersonic airliner. Convair will also be facing the hard fact of several hundred hours of flight time—certainly including some at Mach 3—on B-70 prototypes by then.

Convair is basing its program on the hope that progressive development through the supersonic range, with more complete understanding of the problems all the way along, will be of greater advantage than plunging directly into the Mach 3 speed range. ◆◆



Acceleration and high shock

testing before trigger time, are critical to the quality control of bomb rack components at Singer-Bridgeport. Today high capability in engineering, precision machining and electro-mechanical assembly make Singer-Bridgeport a prime supplier to the military and sub-contractors.

Test facilities provide the range of equipment needed to check out components and systems to close specifications: acceleration, vibration and shock, temperature, altitude, humidity, salt spray conditions. Military and industrial procurement alike find both quality control and quality production at Singer-Bridgeport.

A comprehensive brochure describing these engineering and production capabilities is available to you on request.

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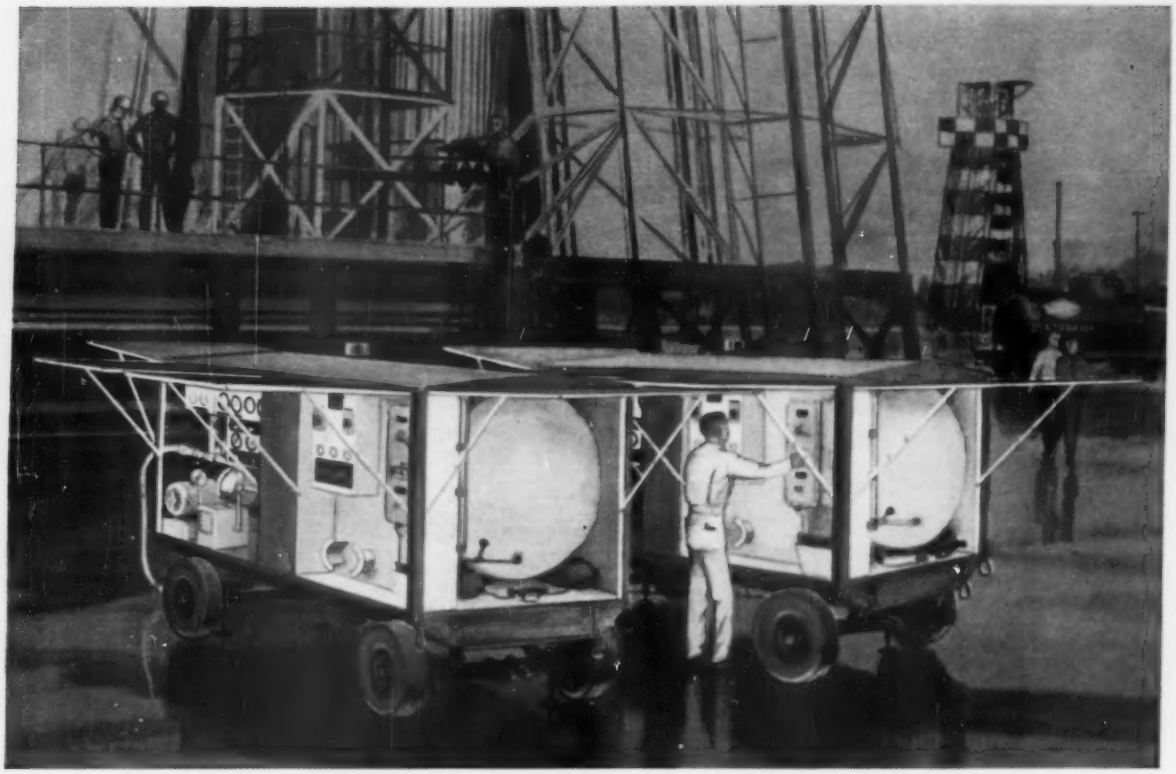


HOW FMC's CHEMICAL AND MECHANICAL EXPERIENCE SOLVES MISSILE PROPELLANT PROBLEMS

Food Machinery and Chemical Corporation, through its integrated divisional operation, offers a unique capability for the design and production of missile propellant handling equipment.

FMC's chemical background covers years of research, development and production of toxic fuels, including high-strength hydrogen peroxide and Dimazine® (UDMH). Utilizing this extensive experience, FMC's Ordnance Division has developed many new processes, systems, and equipment for use in solving critical problems in the handling of missile propellants; among them high-accuracy metering equipment, and the Bomarc decontamination system.

For more detailed information on these studies and for experienced counsel on missile fueling problems, contact FMC, a leading developer and producer of chemical propellant compounds and the equipment to handle them.

For further information, write on company letterhead to Preliminary Design Engineering Dept., FMC Ordnance Division, P.O. Box 367, San Jose, Calif. Phone CYpress 4-8124.

Putting Ideas to Work

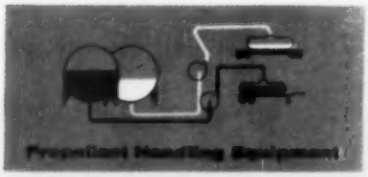
FOOD MACHINERY AND CHEMICAL CORPORATION

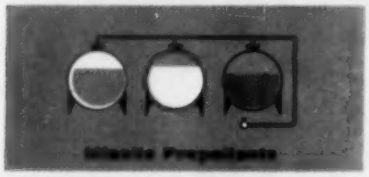
Ordnance Division

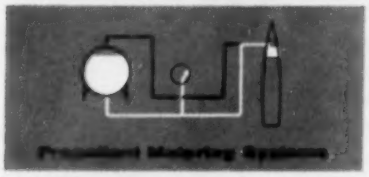
1105 COLEMAN AVENUE, SAN JOSE, CALIF.

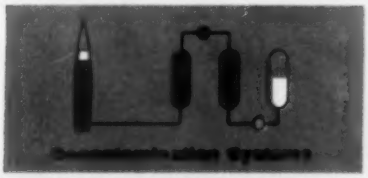
fmc

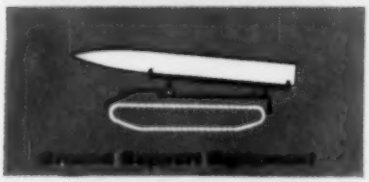
Illustrated below are some of the activities of FMC concerned with missile propellants and propellant handling equipment, which help define a few of the problems successfully solved by utilizing the combination of chemical and mechanical engineering talent available.











FMC's New Liquid Propellant Metering System Achieves Accuracy to ±0.1%

Mobile metering and control unit for fueling liquid propellant missiles.

The crucial reliability of multistage missiles is influenced by the accurate measurement and delivery of liquid propellant to the missile tanks. For example . . . a small error in fuel weight could adversely affect the in-flight performance of the missile, causing possible failure of the entire mission.

Food Machinery and Chemical Corporation's Ordnance Division has recently developed a mobile liquid propellant metering and handling system which promises to solve many missile fueling problems. The advantages offered by this unique new system are many.

Accurately measures and records the amount of fuel delivered to the missile tanks. Original specifications called for a metering accuracy of ±0.2%. Extensive tests, recorded by precision test equipment, show that the system is capable of metering and delivering missile propellants with far superior accuracy—to ±0.1%.

Automatically compensates for factors influencing fueling accuracy. The fuel is continuously sampled and the flow corrected for variations in temperature and density. In addition, the fuel which vaporizes in the missile tanks is returned to the system, condensed, measured, and an equivalent amount added by the metering unit.

Adaptable to many different missile fuels. The system is designed to handle such storable liquid propellants as hydrazine, nitrogen tetroxide, Dimazine® (UDMH) and nitric acid.

Economical to manufacture and safe to operate. To reduce development, manufacturing and operating costs, the system makes maximum use of standard, interchangeable, and commercially available components. The simple and safe design eliminates human errors and danger to operating personnel.

Mobile and compact. All metering, pumping and control equipment is mounted on a single, portable trailer. The complete unit may be easily transported, rapidly positioned, and provides a single station for the monitoring of fueling operations.

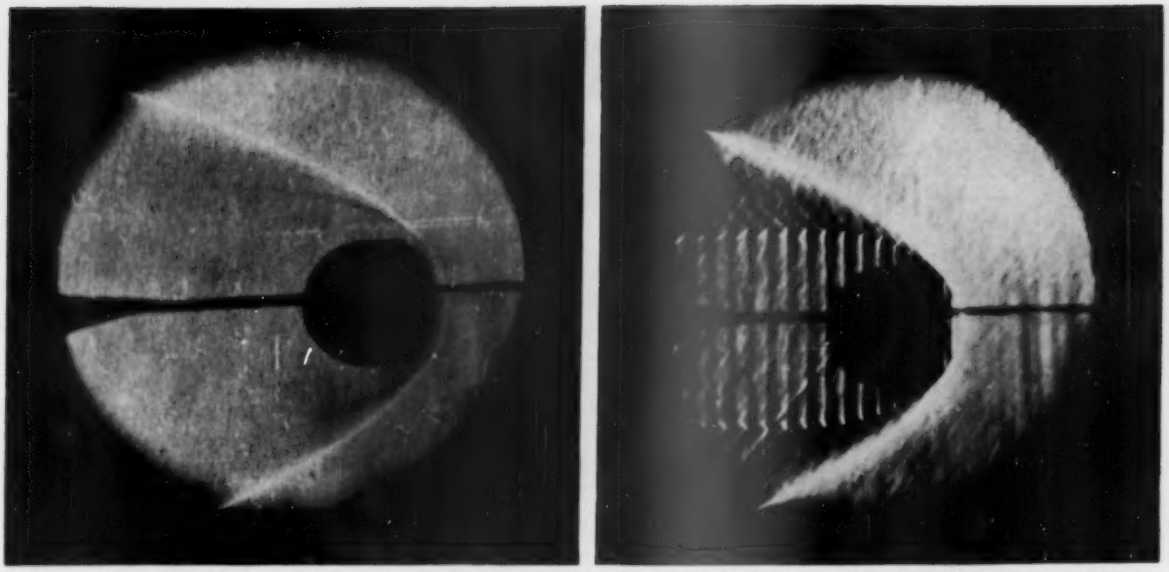
The successful development of this mobile metering and handling system by the engineering staff of FMC's Ordnance Division is another achievement made possible by utilizing the unique combination of chemical and mechanical engineering talent available at Food Machinery and Chemical Corporation.

THE ABC'S OF CRUSADER POWER

Fighter for fighter, the Navy's *Crusader* has logged more flight time than any other 1,000-plus-mph aircraft in U. S. service. Since 1958, this Collier Trophy-winner has flown the Free World's border-watch from Lebanon to Formosa. Over 700 carrier- and land-based *Crusaders* have carried the markings of Navy and Marine Corps squadrons.* This year they are being joined by a new *Crusader* — the all-weather F8U-2N. A missile-firing, radar-packed extension of the basic *Crusader* design, the -2N takes over the Peace Patrol at nearly twice the speed of sound!

CHANCE VOUGHT AERONAUTICS DIVISION DALLAS, TEXAS

*These markings are representative of the 28 Navy and Marine squadrons flying *Crusaders*.



SPHERE at Mach 5.53 (left) shows laminar combustion wave (light) and usual shock (dark) wave attached to front surface. Schlieren photo was taken in National Bureau of Standards experimental program. Intermittent combustion starting at the front of sphere at right moving through hydrogen-air mixture at Mach 4.90 shows the high frequency of the oscillations in clear, shaded bands.

Supersonic Combustion Probed

New technique for studying supersonic combustion by photographing the flight of small hypersonic missiles through combustible gases has been developed at the National Bureau of Standards.

Early results from the experimental method included schlieren pictures of laminar combustion in a supersonic gas stream, probably the first time this phenomenon has been photographed.

Application of the method will provide insight into the problems of stabilizing detonation waves on vehicles in order to reduce the drag or increase the thrust by external burning. Data for the design of flame holders for supersonic combustion could also be one dividend of the program.

Supersonic Combustion

Supersonic combustion has been studied in the past by using shock tubes, closed ducts and free jets.

The Bureau says some of these results have been ambiguous and that the shock tube experiments can't be transposed to the conditions of a moving gas stream and a stationary wave on a fixed object.

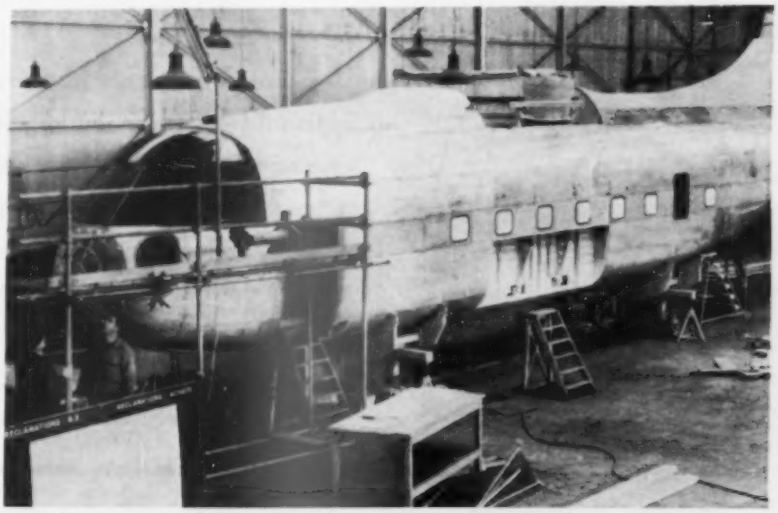
The Bureau's approach, devised by E. W. Ruegg of the combustion controls group, is to establish the shock wave ahead of the moving missile, and then to induce combustion. Stagnation temperatures are realistic, and results are not affected by mixing methods or turbulence.

Nylon spheres of 0.785-in. diameter were fired into a mixture of hydrogen and air at Mach numbers between 4.2 and 6.5. Combustion was started by compression and heating in the shock wave standing on the missile.

One set of tests showed that combustion was steady around Mach 4, with separate shock and laminar combustion waves established at the leading surface of the sphere. But at about Mach 5, combustion became intermittent and at higher speeds the wave appeared to be a strong detonation wave which separated into a shock and a laminar combustion wave.

At pressures of $\frac{1}{3}$ and $\frac{1}{4}$ atmospheres, stagnation temperatures in the detonation wave increased by 1,000C and 700C respectively due to the missile speed.

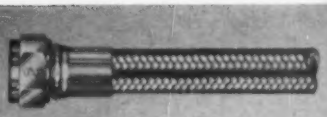
Frequency of the intermittent combustion was estimated at 800 cps.



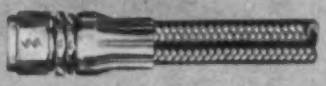
Breguet 941 STOL Prototype Takes Shape

Fuselage of Breguet 941, French STOL cargo aircraft, is out of jigs for installation work on program aimed at first flight next April. Type 941 uses vectored slipstream principle to achieve short takeoffs and landings, turning the slipstream from four tractor propellers driven by Turbomeca Turmo III D turboprop engines. Company is currently showing mockup of Type 942, a pressurized passenger-carrying proposal, to prospective airline customers. Type 942 would carry 50 passengers, or an alternate of 40 passengers and 882 cu. ft. of cargo, in a fuselage with circular cross-section of 9.57-ft. diameter.

SPECIFY STRATOFLEX



SUPER-T TEFLON
124001-S-L
MIL-H-25579 Hose Assembly



SUPER "T-HP" TEFLON
129001-S-L
ARP 604 Hose Assembly

113026-S-L
("113" Hose up to 40% lighter than conventional MIL-H-8794)

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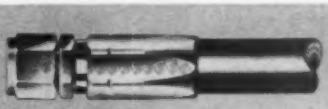
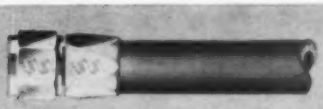


112-313-313-S-L
MS 28759 Hose Assembly
MIL-H-8788 Hose

112-342-342-S-L
MS 28762 Hose Assembly
MIL-H-8788 Hose

111-312-312-S-L
MS 28741 (MIL-H-8795)
Hose Assembly
MIL-H-8794 Hose

FLEXIBLE FLUID LINE REQUIREMENT



193-311-311-S-L
AN-6270 Hose Assembly
MIL-H-5593 Hose

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(Above hose assemblies conform in every detail to specifications listed.)

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French Control System Monitors Flying Speed

Approach control system that monitors the flying speed of an airplane and maintains it at a constant value is being developed by Snecma, French national engine factory.

System is built around throttling the turbojet exhaust nozzle to vary thrust as required to maintain constant flight speed. Experimental flight tests have been made with the delta-winged SE 212 "Durandal," a prototype lightweight interceptor, and the Dassault Mirage III delta-winged interceptor now in production for the French air force. Powerplants used in both airplanes were Snecma's Atar 9 engine rated at 13,200 lb. thrust with afterburning.

Cambodian Air Force Buys Two Alouette Helicopters

Cambodian air force has purchased two Sud SE 3130 Alouette 2 helicopters and plans to buy eight more for use as aerial ambulances, liaison and reconnaissance aircraft.

Pilots and mechanics have been trained in France and a French air force officer has been assigned to Cambodia for technical assistance. Laotian air force previously acquired two Alouette 2s for mountain work.

PRODUCTION BRIEFING

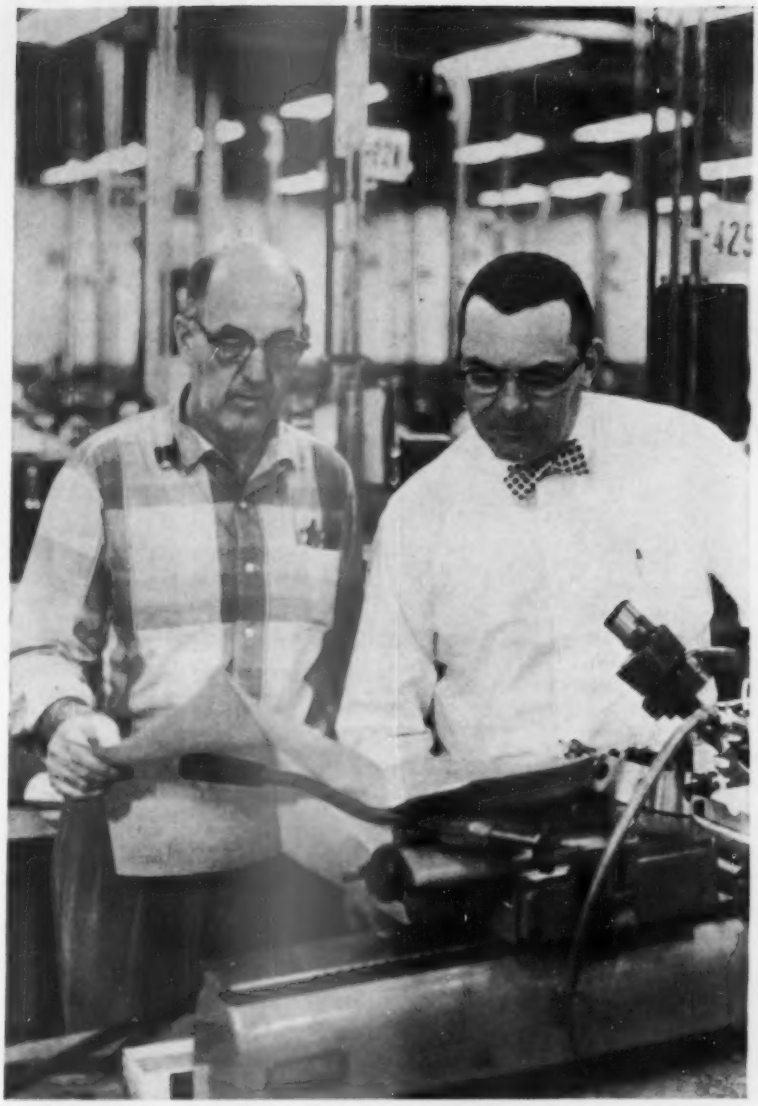
Grumman Aircraft Engineering Corp. received a $35.7 million Navy contract last week for continued production of the S2F-3 anti-submarine aircraft.

Federal Electric Corp., service division of International Telephone and Telegraph Corp., received a $9.3 million Navy contract for the operation and maintenance of the Naval Missile Facility at Pt. Arguello, Calif. for the next three years.

Sperry Utah Engineering Division of the Sperry Rand Corp. received a $3,130,000 Army contract for continued research and development of the Sergeant missile system.

Research Division of Curtiss-Wright Corp. has been given over $500,000 in contracts for research, development and production of beryllium oxide ceramic components for nuclear reactors, including components for the Tory II-A ramjet propulsion reactor.

Aerojet-General Corp. received a $1,359,000 Army contract for production of rocket motors for the Hawk.



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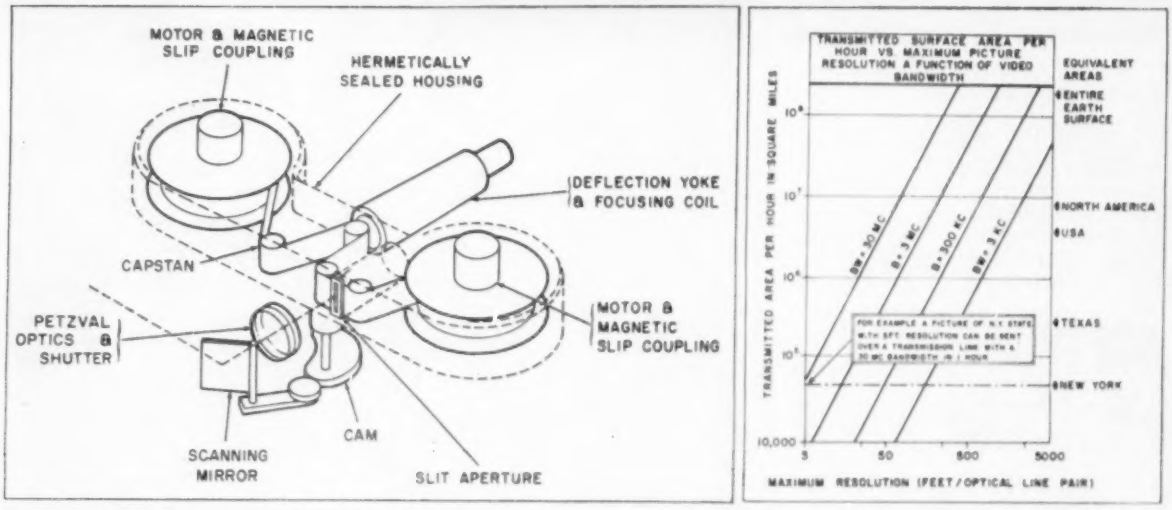


ELECTROSTATIC TAPE camera (left) which records images on plastic tape by means of electrostatic charges, combines many of the advantages of magnetic tape and photographic film without certain of their disadvantages for space applications. New camera developed by Radio Corporation of America, will be used on Nimbus meteorological satellite. Surveillance coverage of earth surface which can be transmitted per hour from a reconnaissance satellite is shown at right as a function of desired resolution and available satellite transmitter video bandwidth in these curves prepared by Radio Corporation of America's Astro-Electronics Division. Larger number of ground stations, permitting longer period of transmission, reduces satellite bandwidth for given coverage.

Nimbus Will Test Electrostatic Camera

By Philip J. Klass

Princeton, N. J.—New type of camera for satellite use, which records images electrostatically on plastic tape, is being developed here for the National Aeronautics and Space Administration's advanced meteorological satellite, Nimbus, by Radio Corporation of America's Astro-Electronics Division.

The new "electrostatic tape camera" proxides an image-recording technique which combines many of the advantages of magnetic tape and photographic film without certain of their disadvantages for space applications.

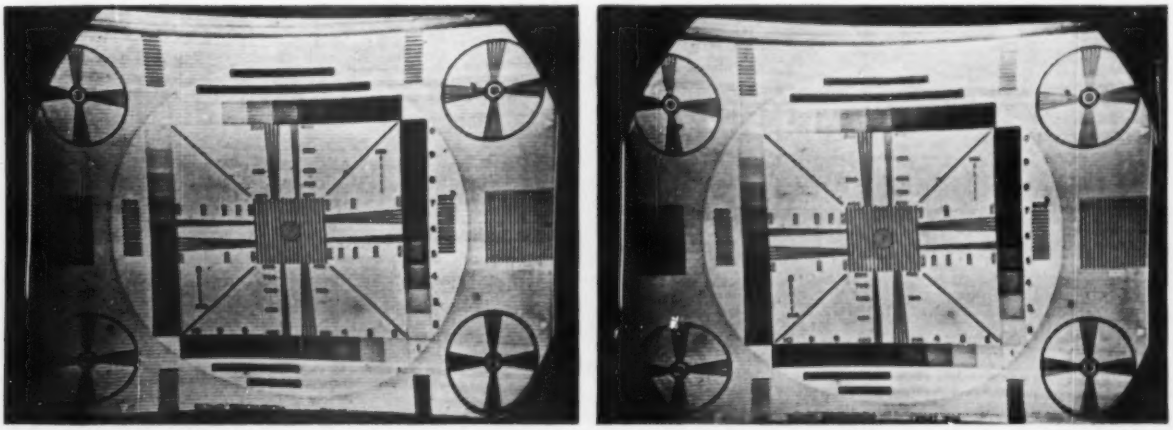
For example, the new camera's plastic film has a data storage capacity which is considerably greater than that of magnetic tape and is comparable to that of photographic film. But like magnetic tape, no on-board chemical processing is required to read out the image. The image can be stored for extended periods, yet can be instantly erased if desired and the plastic film reused.

The electrostatically recorded plastic film could be returned from orbit in a re-entry capsule without danger of damage by Van Allen or other radiation to which photographic film is vulnerable unless heavily shielded, or the image can be read out electronically and transmitted by radio to the earth.

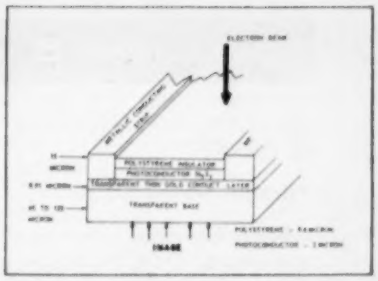
The electrostatically recorded image is read out by an electron beam which can scan at extremely high speed, providing very large bandwidth without the mechanical complexity now required for wideband magnetic tape recorders, according to RCA scientists.

Readout does impair the stored image but four or more successive readouts can be made before there is significant loss of detail.

Because the electrostatic camera combines the record and readout functions in a single unit its over-all image quality is expected to be superior to that obtainable from a conventional television videcon camera and magnetic tape re-



FIRST READOUT of television test pattern image stored for four days on electrostatic tape, shown left, reveals good detail and halftone reproduction. Second readout, shown right, immediately following first shows very slight loss of detail.



ELECTROSTATIC TAPE consists of transparent plastic base, coated with thin gold layer, then a photoconductor and an insulator which carries charge pattern of image.

corder combination, according to RCA.

Although not required for the NASA Nimbus application, the electrostatic camera holds promise of extremely high resolution, according to Richard Callais, manager of analog and video systems for Astro-Electronics Division. This suggests that the new image-recording technique could find use in military reconnaissance vehicles.

Wright Air Development Division's Reconnaissance Laboratory is actively pushing for development of image recording techniques which do not use conventional silver halide emulsions which are vulnerable to radiation from Van Allen belts and nuclear explosions (AW Aug. 1, p. 72).

The factor which limits the resolution of the electrostatic camera is not the grain of the recording medium, as it is with conventional photographic film, but rather the minimum obtainable diameter of the electron beam which is used to read out the stored image.

Experimental models of the new type camera have been constructed to test the principle and a fully operational model is expected to be available within nine months.

A strengthened version, suitable for airborne or satellite use, with resolution equivalent to that obtainable with photographic film, could be built by the summer of 1962, if RCA got the go-ahead today, according to Barton Kreuzer, vice president and general manager of Astro-Electronics.

How It Operates

Although RCA's electrostatic camera and General Electric's new thermoplastic recording technique (AW Jan. 18, p. 87) both use plastic tape as the recording medium, the two techniques are fundamentally different.

(GE's thermoplastic recording uses plastic tape coated with transparent conducting film on top of which is a ½-mil-thick layer of a thermoplastic film. Information is stored on the three-layer film by means of an electron gun which produces a varying pattern of charge. The film then is subjected to

COMPARATIVE DETAIL that can be obtained with two different optical resolutions is shown in these photographs of Newark International Airport. Photo above has resolution of 88 ft. per optical pair, while that below is 8.8 ft./optical pair. Photographs were made using a simulator developed by Radio Corporation of America which permits optical photo to be viewed with a wide range of resolutions.

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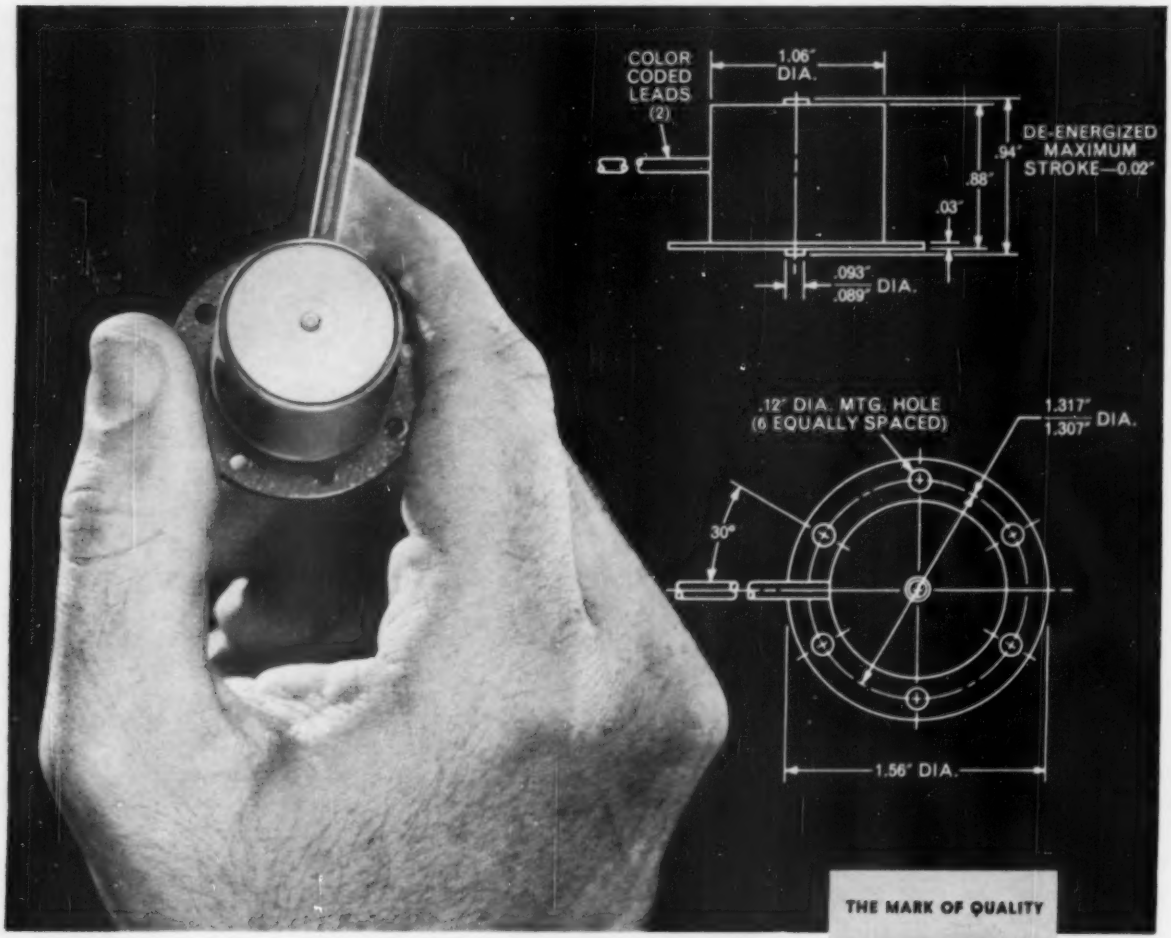
Meets requirements MIL-E-5272C



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RF heating which causes the thermoplastic film to be deformed physically in a pattern corresponding to the charge pattern, after which the thermoplastic hardens. The stored image can then be viewed by running the film through a projector.)

The recording medium for the RCA electrostatic camera is a four-layer tape. The base consists of optically transparent Mylar, called Cronar, measuring 60 to 125 microns thick. (See sketch.) Atop the Cronar is deposited an ultra-thin film of gold, about 0.01 micron thick, which serves as a conductor. Atop the gold is a thin film of photoconductive material, such as antimony trisulfide—also used in commercial TV videcon tubes. Finally there is a thin coating of insulating polystyrene, about 0.6 micron thick. Along each edge of the four-layer tape is a metal conducting strip which makes contact with the thin gold film. These metal strips also serve as spacers when tape is on a reel to prevent adjacent layers of tape from making contact with one another.

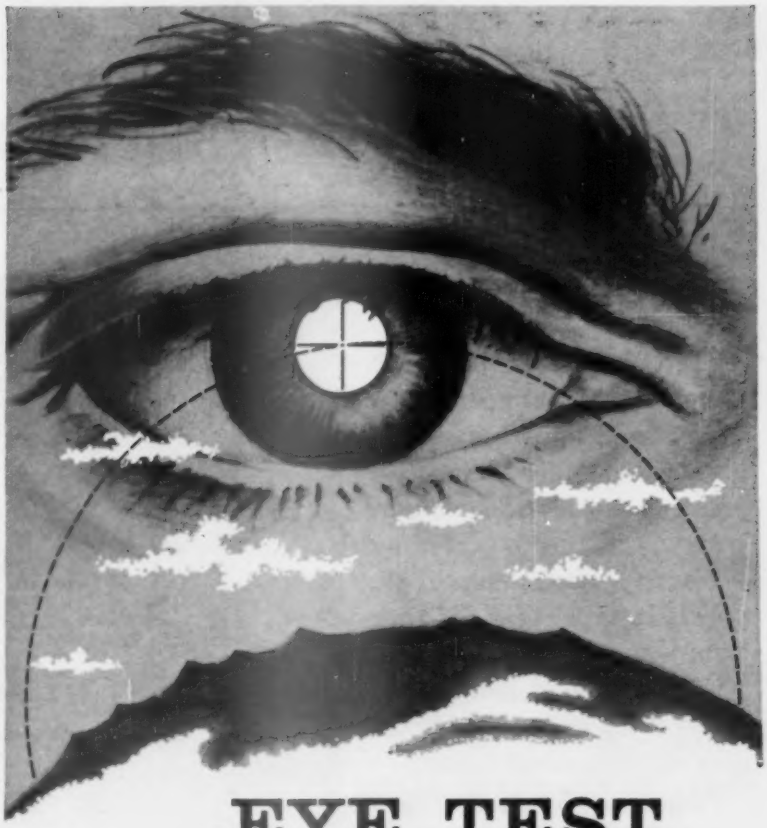
To record on the tape, a broad electron beam floods the entire surface of the polystyrene insulator, building up a voltage potential (charge) between its surface and the gold conducting layer (and the metal conducting strips along the edges).

Simultaneously a conventional optical lens-imaging system projects the desired image on the transparent Cronar base. (See sketch.) The light areas of the image pass through the Cronar base, and also through the ultra-thin gold film which is optically transparent, to fall upon the antimony trisulfide photoconductor. Those portions of the photoconductor that are illuminated by the image become conductive, allowing the charge on the polystyrene insulator to drain off to the gold conducting layer and the metal conducting strips. Those areas of the semiconductor which are not illuminated remain non-conducting and over these areas the charge on the polystyrene insulator remains.

For those portions of the image that are gray-scale (neither white nor black), the photoconductor film will become partially conducting, causing a reduction but not a complete loss of charge on the polystyrene film.

The net effect of the process is to create a pattern of electrostatic charge across the surface of the polystyrene insulator which is a duplicate of the white, black and gray areas of the original image. With proper design and choice of materials, the charged pattern will remain for many weeks, RCA maintains.

The tape is then advanced to another frame and the whole process is repeated to record another picture. Readout of



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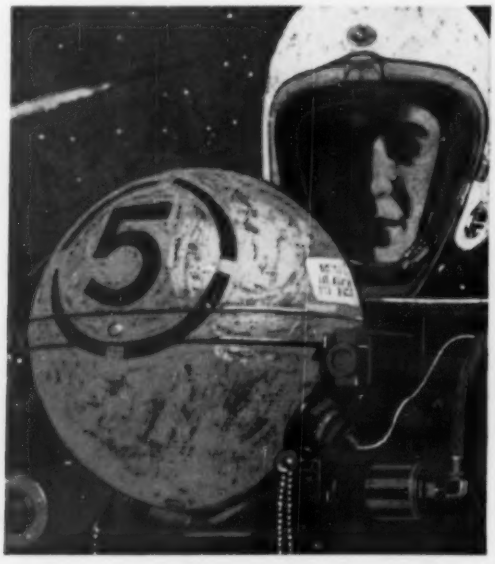

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THE BIG "EAR." The world's largest radio telescope reflector, 600 feet in diameter and more than seven acres in area, is being built by the Columbus Division for the U.S. Naval Radio Research Station in Sugar Grove, West Virginia. The 10-foot thick movable reflector will have a potential range of billions of light years.

the stored image can be made immediately or the tape can be reeled up and readout made at some later time.

To convert the electrostatic image on the tape into electrical signals which can be transmitted back to earth, the tape is moved into position in front of an electron beam. This one must be tightly focused for optimum resolution, in contrast to the flood beam used to produce the initial charge on the polystyrene surface.

The readout beam is caused to scan the surface of the polystyrene insulator by conventional electromagnetic (or electrostatic) deflection plates. As the electron beam contacts each spot size area, the amount of beam current that flows at that instant will be inversely proportional to the electrostatic charge level of that area and therefore directly proportional to the light intensity of the original image at that point.

The readout of the image by the finely focused electron beam results in some loss of charge differential between light and dark areas of the original image.

In a demonstration for AVIATION WEEK, an image that was recorded six hours earlier was read out four times before there was significant loss of detail.

To erase the electrostatically stored image, the entire polystyrene insulator surface is illuminated by a flood-type electron beam which equalizes the charge across the entire surface.

Performance

The halftone rendition of the electrostatic tape camera is equal to that obtainable from conventional TV videcon cameras, according to RCA scientists.

The quantum efficiency of the semiconductor/photoconductor is about 50%, making it comparable to photographic films in sensitivity.

A peak highlight exposure of 0.01 foot candles per second is adequate for photographing a standard TV test pattern, according to RCA. With the use of electronic image intensifying techniques, now under investigation here, the electrostatic tape camera could operate at light levels only 1/1,000th as high. A three-stage image intensifier could cut required light level by a factor of perhaps 50,000:1, RCA believes.

The most significant factor in determining the resolution obtainable with the new electrostatic tape camera is the spot size of the readout electron beam. Considerable effort is under way at RCA in developing techniques for reducing beam spot size. One promising technique is to use a magnetically shielded cathode.

Company scientists here are confident that within several years it will be

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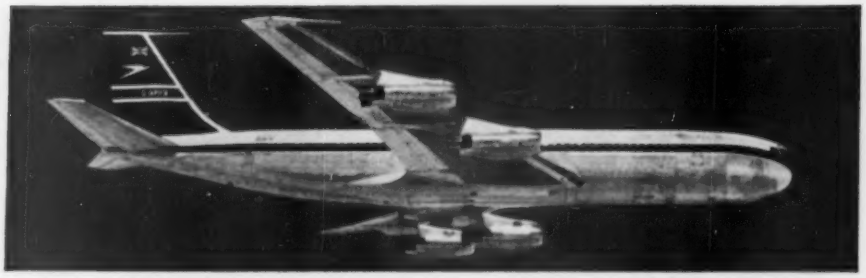
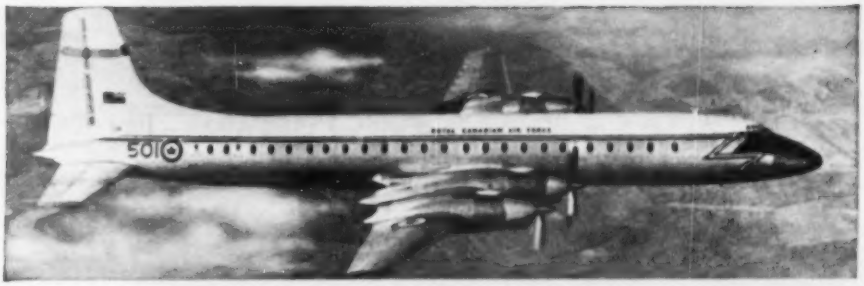


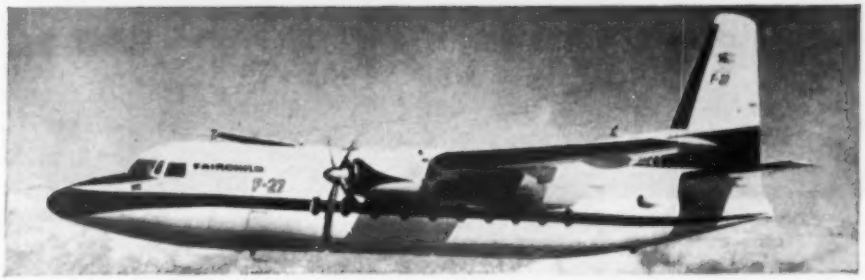
DOUGLAS DC-8/40
CONWAY
BY-PASS TURBO JET

CANADAIR FORTY FOUR
TYNE PROP-JET



GRUMMAN GULFSTREAM
DART PROP-JET

FAIRCHILD F-27
DART PROP-JET



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possible to produce electrostatic tape cameras that can match the limiting resolution of about 100 optical lines per millimeter obtainable with conventional photographic films.

Callais points out that the whole question of photographic resolution, in terms of being able to discriminate between different objects of interest, is neither well defined nor understood at present. (National Bureau of Standards has recently developed a new camera capable of projecting 50,000 lines per inch, to be used as a research tool for developing "a standard method for determining the resolving power of photographic materials," because there is no such standard at present.)

Imagery Simulator

RCA's Astro-Electronics Division has constructed an imagery simulator which it uses for experimentation to evaluate the effect of resolution, noise and special electronic processing techniques on a human observer's ability to pick out important details from an aerial or satellite photograph.

The simulator can produce a TV picture with a resolution ranging from 120 to 1,000 lines. Noise can be injected to correspond to that encountered in radio transmission, to determine its effect on interpretability. Controls permit the operator to stretch the gray scale of the picture to bring out more detail, or to outline areas of equal brightness (or darkness). This is particularly valuable in analyzing meteorological satellite photos of cloud formations to locate the most intense energy levels. Other controls, which differentiate the video signal, producing a visual display which resembles a relief map, also can be used to bring out details which might otherwise elude the human observer.

The Astro-Electronics Division also is developing a new means for producing photographs of video information radioed back by satellite at ground receiving stations. At present this is done by recording data on magnetic tape, playing it back over a TV-type monitor, then photographing the monitor with a camera.

RCA believes this operation can be performed in a single step by using an electron beam, modulated by the received video signal, to record the picture directly on photographic film. (The same principle has been used in electron microscopes.) In this way the distortion which occurs in the camera lens and the smearing that occurs on the TV screen phosphor will be eliminated. Here, as with the electrostatic tape camera, the resolution will depend upon the ability to obtain a finely focused electron beam.

The division here is building an experimental model, using five-inch wide film, which is expected to be completed early next year.

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The addition of our second factory means delivery in six to twelve weeks on many other G-M Servo Motors and Motor Generators as well; sizes 8 to 18, including other BuOrd items.

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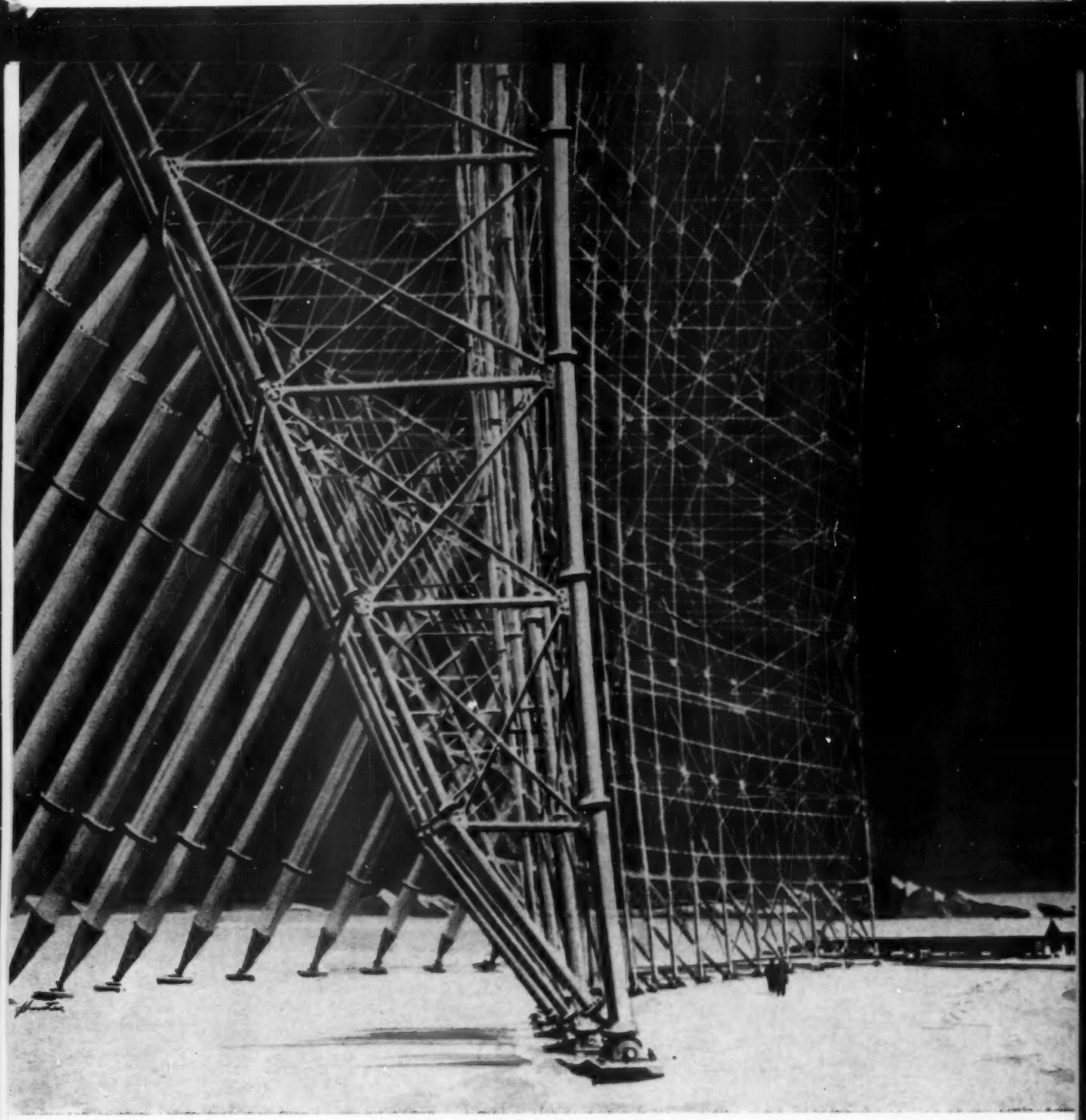

Somewhere North of Baffin Bay

The Arctic is almost as silent and lifeless as an ice-cube. But, deep inside it, these 400-foot long missile-detection antennas will guard the life of our country.

They're part of a Ballistic Missile Early Warning System (BMEWS). Officially, you'd call them surveillance radar antennas. Yet, they look like over-sized baseball mitts. That web-like framework can detect (or spot) a far-off missile darting through the shivering Arctic sky, and rifle its speed and direction to any of our military bases in seconds.

Up here, weather is a constant battle. Arctic storms slam into the 163-foot high antennas, and rake icy fingers back and forth over the mesh-faced structures. But they'll stand for years. The D. S. Kennedy Company, builders, made certain of that by weaving foot after foot of USS National Seamless Mechanical Tub-

ing into every antenna.

USS National Seamless Mechanical Tubing is an ideal load-carrying member, because it resists bending stresses in all directions and gives you a superior cross section. It absorbs and localizes shock. And for a given size and weight, the tubular form withstands more load than other sections.

USS National Seamless Mechanical Tubing also fabricates easily into parts. It's stocked by National Tube Distributors all over the country. They will gladly show you how to use USS National Mechanical Tubing in your next application. *See your National Tube Distributor.*

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This mark tells you a product is made of modern, dependable Steel.

National Tube Division of United States Steel

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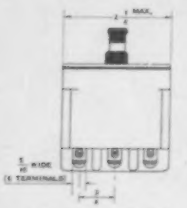
United States Steel Supply Division
United States Steel Export Company, New York

Micro-Miniature — ½ to 5 amp. — 7274-2 Series • Miniature — 5 to 35 amp. — 7280-2 Series • Three Phase — Simul-Trip — D6760 Series (MS24549)

GET THE EXTRA SPACE SAVINGS – GET THE EXTRA RELIABILITY

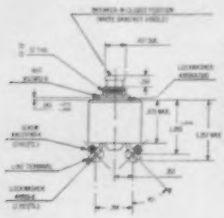
Exclusive Characteristics of these KLIXON® Circuit Breakers



SIDE VIEW TRIPPED D6760-1 A-2

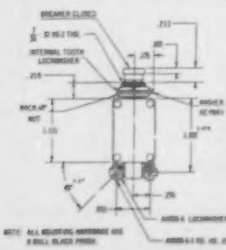
D6760 Three Phase (MS24549)

Thermal type. Interrupts high AC short circuits . . . trips quickly . . . provides simultaneous tripping of all three phases should any one phase become overloaded. Phases can be different ratings.



7280-2 Miniature

Trip-free, push-pull, 5-35 amp. circuit breaker providing maximum protection to aircraft and electronic gear cable plus exclusive weight and space saving advantages of 30% in volume, ½" in depth and 10 grams in weight.



7274-2 Micro-Miniature

Sets new standards in size, weight and performance. Fast tripping response provides positive protection for low thermal mass components in aircraft, radio and electronic gear.

Characteristics	7274-2 Series	7280-2 Series	D6760 (MS24549) Series
Performance	28 VDC and 120 VAC to 400 cps; all ratings unlimited rupture on 28 VDC; ½ to 1½ amps unlimited rupture on 120 VAC; 2 to 5 amps. rupture capacity to 800 amps., 120 VAC on 120 VAC. ½ to 1½ amps. unlimited rupture, and 2-5 amps. 800 amps. rupture.	28 VDC and 120 VAC to 400 cps. All ratings on 28 VDC, 6000 amps. rupture; on 120 VAC, 2000 amps. rupture.	Min. AC rupture capacity 1500 amps., 3φ, 120 VAC, 400 cps, 2500 amps., 1φ, 120 VAC, 400 cps.
Ratings	½ to 5 amps.	5 to 35 amps.	5 to 60 amps.
Limits of ultimate trip (25°C)	115% min. 145% max.	Hold 115% Trip 138%	3φ balanced load: 105% – 138%; unbalanced load: two phases – 100% one phase – 145%.
Overload calibration at 200%.	2 to 20 sec.	7 to 45 sec.	3φ balanced load: 10 to 60 sec.
Max. operating force. Open and reset.	5 lbs. open and reset	8 lbs. – open 12 lbs. – reset	8 lbs. – open 15 lbs. – reset
Shock, minimum.	35 G's	25 G's	25 G's
Vibration, minimum.	10 G's to 2000 cps.	10 G's	Procedure I, MIL-E-5272, except 5 G level for 5 amp. rating.
Weight.	0.9 oz.	1.25 oz.	8 oz. approx.
Optional features.	Available with aux. control circuit (7274-4).	Available with special locking terminals (7280-6).	Available in 2-hole (D6760-4) or 4-hole (D6760-1) mounting.

The D6760 three-phase breaker provides extra reliability because it is internally ganged — one button, one case, no mechanical linkage. There is none other like it. This breaker and the 7280-2 and 7274-2 are the smallest available — offering extra advantages in weight and space savings.

*Trademark of Texas Instruments Incorporated

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SPC-48

Data Processing Advances in West Europe

Washington—Digital computer technology in the United States, sparked by large U.S. military funding for defense purposes, is several years ahead of data processing in Western Europe. But West European scientists are doing excellent work in computer theory and concepts, and their industry is mushrooming as it has in the U.S.

This is the appraisal of Isaac L. Auerbach, top computer specialist who has just completed a seven-week survey tour of West European computer laboratories and facilities under the sponsorship of the Office of Naval Research. Auerbach, who heads a computer-datamation engineering firm bearing his name, did not visit Russia during this trip.

Progress Report

Auerbach ranks Britain second to the U.S. at present in the status of its computer technology, but expects Russia will be number two within five years. Germany and Japan also are moving up fast, he says.

Auerbach cites reports that the Red Chinese continue to astound the Russians with their speedy development of computer technology. One year after Red Chinese scientists visited Russia for a look at the Soviet Bessem digital computer, they had constructed a much-improved version, Auerbach says.

"The area of information processing is vitally important to every nation," Auerbach says. "There is no doubt that the quantity of a country's information processing systems is as valid an index of its economic progress as, for example, kilowatt hours of electric power or tons of steel it produces."

Research in pattern recognition and self-learning machines is under way in many West European countries, as in the U.S., Auerbach reports. Among the more interesting programs cited by Auerbach were the following:

• **Alpha-numeric character** recognition, using novel technique which overcomes imperfections in the character or deviations from the idealized character shape, is under investigation at Technishe Hochschule Karlsruhe, Germany. Total of 19 measurements made as the character is moved around a resistance matrix are sufficient to identify the character. Technique is based on principle of measuring character shape by the potential gradients its shape produces.

• **Technishe Hoschule** Vienna is experimenting with magnetic cores to attempt simulation of conditioned reflexes.

• **Solartron Electronic Group, Ltd.,** Britain, has developed a device capable of reading fixed type face characters at a rate of 240 per second, and rate can be increased up to 3,000 per second, Auerbach was told.

Storage-Memory

The University of Manchester, Britain, has developed a new type of fixed high-speed memory for storage of read-in commands and sub-routines. It is similar in operation to ferrite core memory, except that it uses solid rods which eliminate the costly and difficult task of threading tiny cores. The memory consists of a large piece of metal mesh, resembling a window screen, with ferrite rods and flux-return rods placed in the holes between the wires. One unit which Auerbach saw, measuring approximately 3 x 8 ft., stores 8,192 words with an access time of less than 0.2 microsecond and cycle time of less than 0.4 microsecond. Memory will be used in University of Manchester's MUSE computer and the

West European Computers

Major computer manufacturers and laboratories in West Europe, and the names/designations of computers they produced or now have in development, cited by Isaac L. Auerbach, include the following:

▶ GREAT BRITAIN:

• LEO Computers, Ltd.: LEO I, II and III.
• Ferranti, Ltd.: Mark I, Pegasus I, II, Mercury, Perseus, Argus, Sirius, Atlas, Orion and Apollo.
• Elliott Bros.: 402, 405, 802, 803 and 503.
• EMI Electronics, Ltd.: EMIDEC 1100, 2400.
• International Computers and Tabulators, Ltd.: 1202, 1301.
• Standard Telephone & Cables: STANTEC Zebra, STANTEC System.
• Solartron Electronic Group, Ltd.: Minispace, Space 30.
• English Electric Co., Ltd.: Ace, Deuce.
• University of Manchester: Muse.

▶ FRANCE:

• Compagnie des Machines Bull: Gamma 3, Gamma 60 and 300 DP.
• Societe D'Electronique et D'Automatisme (S.E.A.): CAB 500, CAB 3030, SEA 3000 SEA 3900.
• Societe Nouvelle D'Electronique (S.N.E.): KL-901.

▶ WEST GERMANY:

• Siemens & Halske: 2002.
• Telefunken: TR-4, TR-5.
• Olympia Werke: Omega.
• Standard Elektrik Lorenz: ER-56.
• Zuse: Z-22, Z-23, Z-31.
• Max-Planck-Institut fue Physik Munich: G-3.
• Technische Hochschule Munchen: PERM.
• Technische Hochschule Darmstadt: DERA.

▶ ITALY:

• Olivetti: ELEA 9003, ELEA 6001.
• University of Pisa: CEP.

▶ SWITZERLAND:

• Swiss Federal Institute of Technology: ERMETH.

▶ THE NETHERLANDS:

• N. V. Electrologica: X-1.
• N. V. Phillips: Pascal, Stevin, Mona Lisa.
• Mathematisch Centrum: Armac, Ferta.

▶ SWEDEN:

• Facit: BESK, EDB-2.
• Aktiebolaget Bo Nyman (A.B.N.): Wegematic 1000.
• Swedish Board for Computing Machinery: Besk.

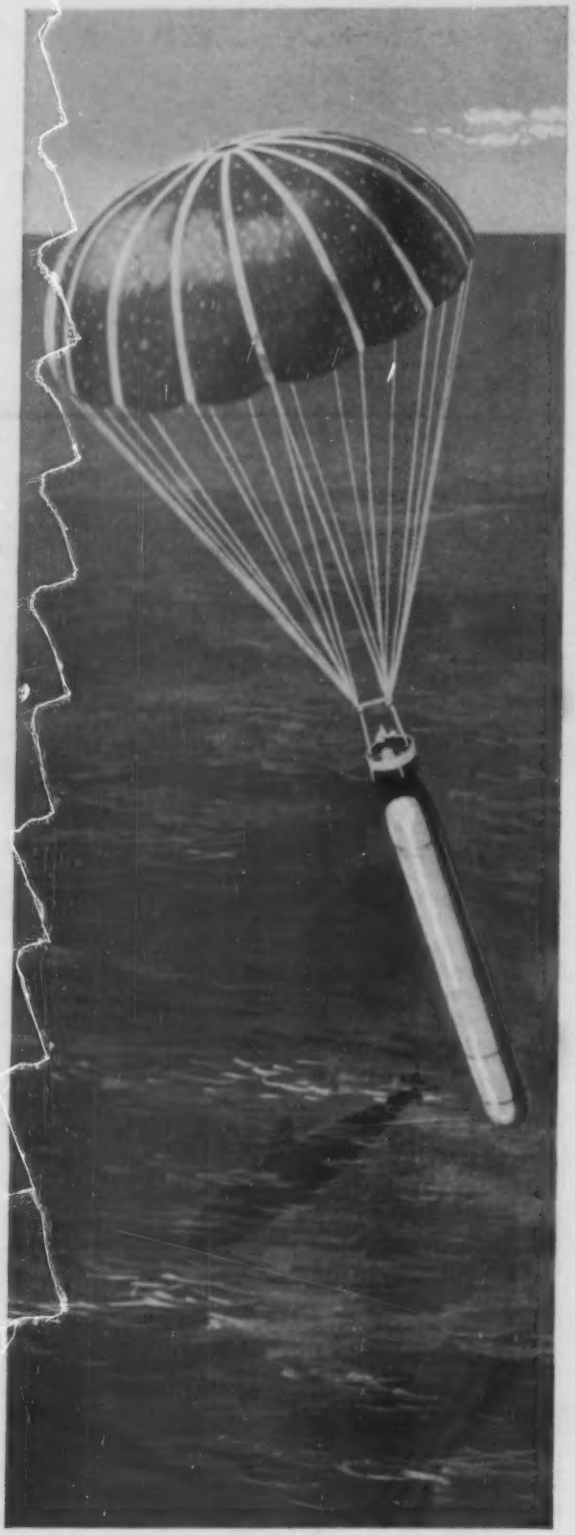
▶ DENMARK:

• Regnecentralen: Dask, Gier.

▶ AUSTRIA:

• Technische Hoschule Vienna: Mailuefterl. (English translation: "Mild spring breeze," a spoofing commentary on the machine's speed and capacity compared with the U. S. "Whirlwind" computer, originally developed for air defense problems.)

1. Within seconds after detecting an enemy submarine, a shipboard computer automatically charts the sub's course, range and speed . . . then aims the missile launcher. Upon command, a rocket-propelled ballistic missile is fired.



2. The missile follows a ballistic trajectory, shedding its rocket motor and airframe before water entry. When the payload is a torpedo, a parachute blossoms in flight to slow the missile's plunge into waters near the target.

3. After hitting the water, the ASROC torpedo becomes activated by the energizing of a sea-water battery. Then, the missile begins an acoustical homing search from which it locks onto its target and pursues it to destruction.

Swift and precise sequential control of Honeywell's ASROC provides the first long-range anti-submarine weapon

From initial sonar detection through firing and ultimate target contact, ASROC's automatic system delivers an unerringly destructive missile from thousands of yards away—all in a matter of seconds!

Development of ASROC started with an idea and tens of thousands of unanswered questions. Hoping to find the answers, the Bureau of Naval Weapons gave Honeywell, as prime contractor, the responsibility of designing, developing, testing and producing the entire system under technical direction of the Naval Ordnance Test Station.

The ASROC concept was based on present knowledge at the time the program was initiated, but it remained for exhaustive test programs, carried out by the Navy-Honeywell team, to develop ASROC from idea to hardware.

Early in the program, prototype missiles were test fired statically and from moving platforms at the Naval Ordnance Test Station to obtain aerodynamic research information. Engineers measured, recorded and computed items and distances for thrust termination, airframe separation and payload impacts.

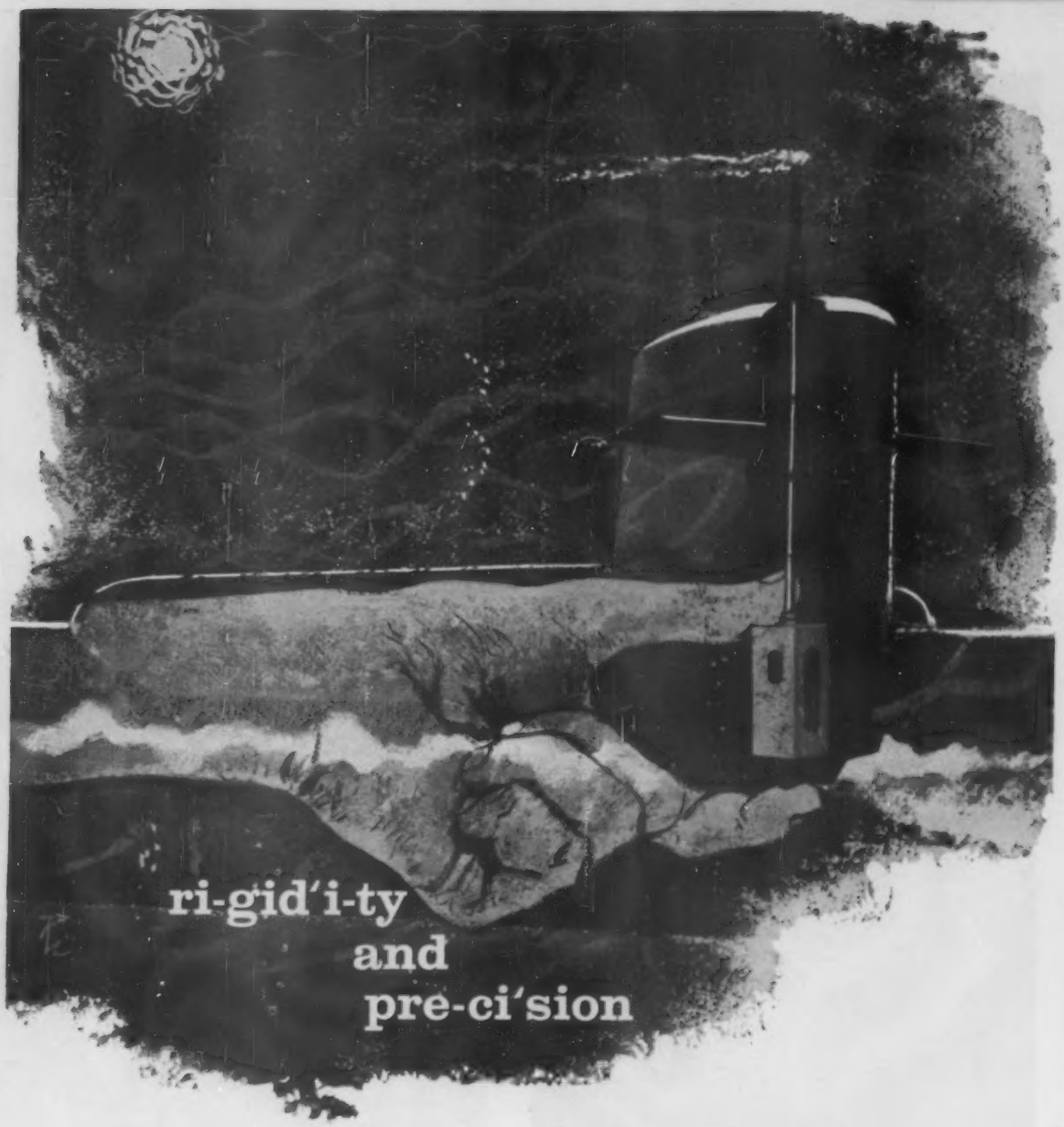
Hydroballistic information was obtained from dummy payloads fired into the water from a test stand and dropped from airplanes into a hydrophone range. Calculations on trajectory, hydrodynamic stability and depth-time ratios contributed to design. Throughout the development program, more than 200 test firings were conducted.

The result is an integrated weapon system consisting of an underwater sonar detection device, an electronic digital fire-control computer, a missile launcher, the ASROC missiles and all necessary training equipment.

The facilities of 14 Honeywell divisions are available for development of any complex control problems of missile or aircraft systems and components. If you have a problem in the design of systems or components, call or write: Honeywell, Military Products Group, Minneapolis 8, Minn. In Canada, write: Honeywell Controls, Limited, Vanderhoof Avenue, Leaside, Toronto 17, Canada.

Honeywell

Military Products Group



The Task — Provide celestial accuracy for massive sensing devices. The Solution — Hydrostatic bearings for smooth, rigid, "frictionless" support.

In Polaris submarines and other military applications, these hydrostatic bearings, developed by Nortronics, are particularly suited to virtually frictionless support of a large structure, which can be positioned accurately by a servo system with no unevenness, runout or binding — yet extremely stiff under applied loads.

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Boeing Antenna Design Models

Steerable antenna for radio astronomy, scaled down from a 200-ft. diameter, is checked by Boeing engineer-designers. At left is model of an 80-ft. radial truss antenna used for satellite tracking. At center is another model of an 80-ft. satellite tracker, and at upper center is corner section of a rotating radar surveillance antenna.

Atlas being built by Ferranti, Ltd.

The Atlas will have a storage capacity of one million words, half of it provided by the ferrite rod matrix, the other half by magnetic drum. Interesting feature of the machine will be its ability to "learn" which elements in the rod matrix are not being used during any portion of the problem and to automatically transfer this information to a magnetic drum to make room in the matrix for other more frequently used commands.

Wired Core Storage

Auerbach found considerably more interest in and use of wired core and coincident memory storage in West Europe than in the U. S. In The Netherlands, N. V. Electrologica has developed a novel machine for mechanized wiring of tiny ferrite cores. Machine operates under control of a punched tape program.

Moderate-cost, large capacity, random access tape unit is being developed by Standard Elektrik Lorenz of West Germany, for handling air passenger reservations of British European Airways and Air France. The memory, called the K-10, employs 10 tape handler bins in which magnetic tape is stored. The K-10 bears some resemblance to an older Burroughs device. Each bin holds about 328 ft. of tape, each capable of storing three million

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Red unlock indicator
Secondary extreme vibration lock
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½" take-up • 8 to 1 mechanical advantage

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A handsome, strong and durable handle latch to fasten "plug-in" type electronic chassis, providing for positive ejection and injection of the chassis and allowing an eight to one mechanical advantage, with a total one-half inch take up.

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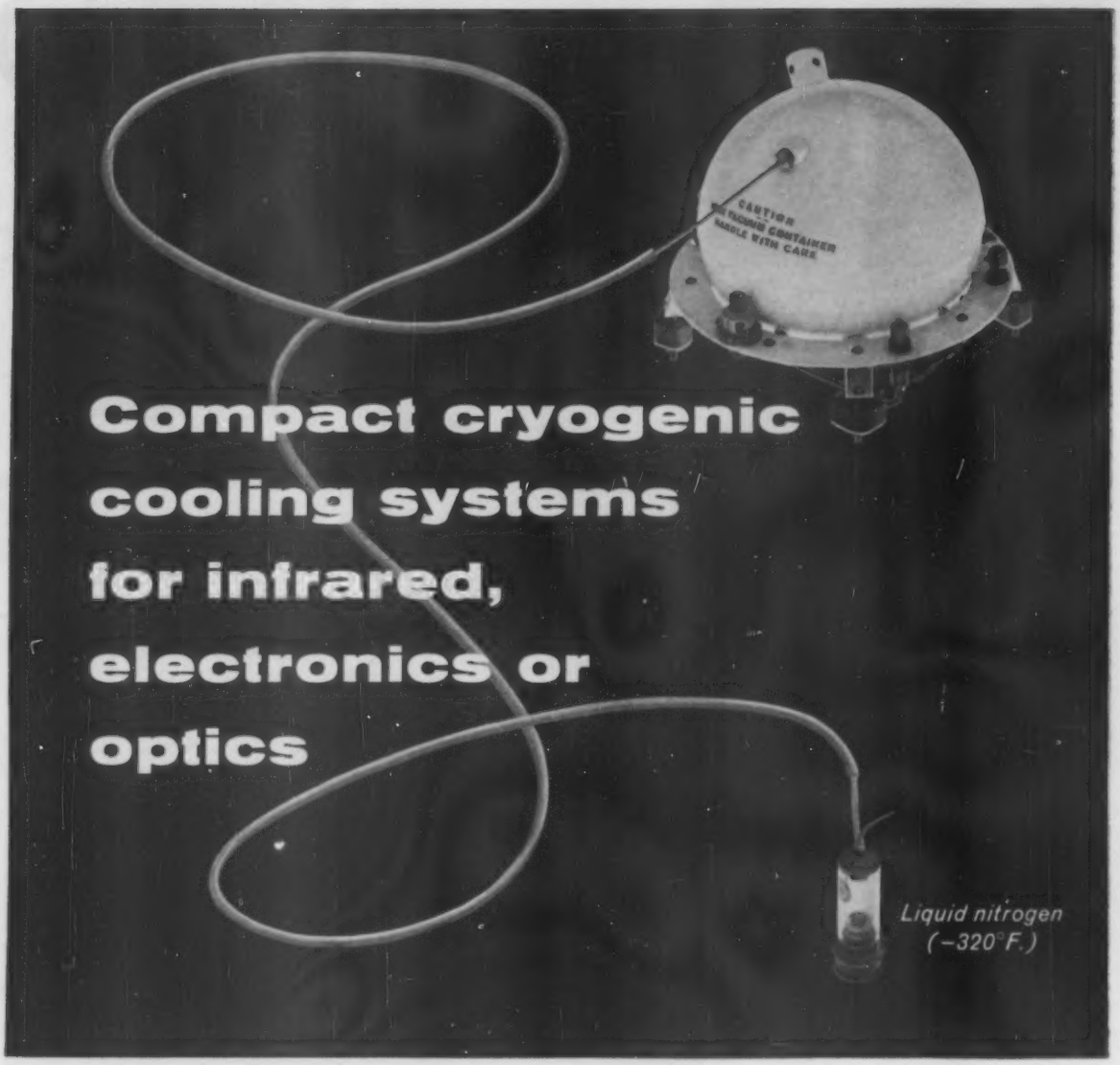
PRECISE DC TO DC AMPLIFIER

This new amplifier assembly consists of an input mechanical modulator, a high gain AC amplifier and an electrical demodulator output. With associated Kearfott network assemblies D4818 or D4819, this assembly functions as a DC operational amplifier with a gain in the range of 1 to 10 — with an accuracy of ±0.02%. The amplifier is also capable of delivering 10 volts DC to any load in excess of 5000 ohms.

KEARFOTT DIVISION
Little Falls, New Jersey

GENERAL PRECISION, INC.
Other Divisions: GPL, Librascope, Link



New AiResearch system delivers nitrogen in liquid form from storage system to cooling area

Now units requiring cryogenic cooling no longer need be designed with allowances made for bulky expanders or adjacent storage tanks.

The new AiResearch system transfers the coolant *in liquid form* to a point of use *25 feet or more away*. The liquefied gas passes through an uninsulated, small, flexible tube which can be bent over and around obstructions. Because the storage system can be placed anywhere, space limitations are overcome and vehicle installation problems are simplified.

The complete system includes the cryogenic liquid container, pressure and flow controls, the liquid transfer tube and cooling adapter. The system can be operated without external power. It can be used with missile, aircraft, space or ground based units and can be converted to a closed-cycle system with the addition of a small gas liquefier.

AiResearch has pioneered many new developments in the cryogenic field. It is presently engaged in work on systems utilizing helium, hydrogen or neon as coolants, and cryogenic systems for zero G operation.

• *Please direct inquiries to Los Angeles Division.*

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AiResearch Manufacturing Divisions

Los Angeles 45, California • Phoenix, Arizona

Systems and Components for: AIRCRAFT, MISSILE, SPACECRAFT, ELECTRONIC, NUCLEAR AND INDUSTRIAL APPLICATIONS

decimal digits, with an average access time of 10 sec. The device can read out or write in simultaneously on four tapes. The unit will sell for less than $18,000, Auerbach was told.

Thin Film Memory

In West European laboratories, as in the U.S., there is considerable effort in thin film storage. International Business Machines Corp.'s laboratories in Zurich are doing basic research in this field. Their finding that thin films have an intrinsic ferromagnetic resonance of about 1,000 mc. suggests that the fastest access time available with thin films will be of the order of 0.1 microsecond, unless they are operated as parametric amplifiers. IBM Laboratories studies indicate that the magnetic domains lock onto impurities in the crystal as they advance along the film.

New material for thin films, called Gyra Alloy, developed by Britain's International Computers and Tabulators, Ltd. (ICT), reportedly eases the problem of thin film reproducibility. Thin film storage matrix made with the new alloy has demonstrated access times of tens of nanoseconds, Auerbach was told.

However, Auerbach expressed the view that considerably more research is required before thin film memories reach the stage that they can be economically produced in large arrays.

FILTER CENTER

Important new developments in power tubes and semiconductor devices and techniques reported at the recent National Electron Devices Meeting in Washington include the following:

▶ **High Power Traveling Wave Tube**—A traveling wave tube which produces peak power of more than 4.0 megawatts and average power of 8.0 kw. at S-band, with efficiencies as high as 47% and power bandwidth of more than 14%, was described by John Ruetz of Varian Associates.

▶ **Helix Parametric Amplifier**—New type of parametric amplifier which uses a helix as a slow-wave distributed interaction structure and employs variable-capacitance semiconductor diodes which are distributively coupled to the helix, was described by C. L. Cuccia and K. K. N. Chang of Radio Corporation of America. The RCA scientists described a miniature helix parametric amplifier, weighing less than 6 oz., which provides 15 db. gain across a 10% bandwidth in high L-band using a pump frequency that is less than twice the input signal frequency. Gains of more than 30 db. have been obtained over narrow bandwidths in the fre-

PROBLEMATICAL RECREATIONS 40

A college president, a professor, an instructor, and a janitor are named Mr. Brown, Mr. Green, Mr. White, and Mr. Black, but not respectively. Four students with the same names will be designated here as Brown, Green, White and Black. The student with the same name as professor belongs to Black's fraternity. Mr. Green's daughter-in-law lives in Philadelphia. The father of one of the students always confuses White with Green in class, but is not absent-minded. The janitor's wife has never seen Mr. Black. Mr. White is the instructor's father-in-law and has no grandchildren. The president's oldest son is seven. What are the names of the president, professor, instructor, and janitor?

—Contributed by a Recreationer

For information on custom magnetic recording heads, write to Westrex Recording Equipment Dept., Westrex Corporation, 6601 Romaine Street, Hollywood 38, Calif.

ANSWER TO LAST WEEK'S PROBLEM: Since the intensity of sound diminishes as the square of the distance from the source, the intensity of the sound made by the three noise makers six feet away may be represented by the number 3/36 and that of the two at a distance of four feet by the number 2/16. Thus the disturbance made by the two E.E.s would be 1½ times as intense as that of the three M.E.s.

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Beverly Hills, California

QUADRATURE
REJECTION CIRCUIT

Kearfott's quadrature rejection circuit is designed to operate from a pre-amplifier or gain controlled amplifier into a transistor servo amplifier. This small, light and rugged device rejects the component of the input wave which is 90° from the reference input. The component of the input sine wave which is in-phase with the reference will produce a square wave whose magnitude is proportional to load and magnitude of in-phase signal. Kearfott's high-performance rejection circuit is designed to accept an input signal up to 6 volts (rms); assuming a signal input of 0.15 to 4.0 volts, the rejection ratio will be 50:1.

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. . . rely on the **dynamic analysis** capabilities of Allied Research.

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Infrared Lens Material

New infrared lens material, Irtran-2, passes 70% of energy in the 2½ to 10 micron wavelength region, with virtually no scattering in the 3 to 9 micron region, according to manufacturer. Refractive index averages 2.25. Material can be formed and polished to a maximum diameter of 6½ in. and thickness of 1 in. Manufacturer: Eastman Kodak Co., Rochester 4, N. Y.

quency bands of 2,200-2,300 mc. and 1,800-2,000 mc. Terminal noise figures as low as 4.5 db. have been measured. Maximum gain is stable over wide range of pump power. When pump signal is turned off, there is approximately 30 db. insertion loss between input and output terminals.'

► **Thermo-Electric Cooled Par-Amp**—Excess noise temperature of diodes used in parametric amplifiers can be significantly decreased with a modest amount of cooling below room temperature by means of simple thermoelectric cooling, according to Michiyuki Uenohara and Robert M. Wolfe of Bell Telephone Laboratories. The authors described a 6-kmc. parametric amplifier, constructed at BTL, which uses a built-in two-stage bismuth telluride thermoelectric refrigeration unit for cooling the diodes. Excess noise temperature was cut from normal 170K at room temperature to 114K and further improvement should be possible.

► **Microsecond Response Electroluminescence**—Westinghouse Electric's J. E. Johnson reported that electroluminescent cells using plastic-embedded powder phosphor can be excited to high intensity within one microsecond if the exciting burst of a.c. energy has a d.c. component equal to one-half the a.c. peak-to-peak voltage. Decay time is about seven microseconds. Rate of rise of electroluminescent brightness varies with the repetition rate of the a.c. burst, and use of a square-wave gives higher total light output than does a sine wave, Johnson reported. Measurements have

TIME TEAM

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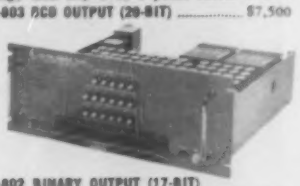
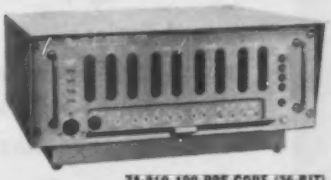
Look at these unparalleled advantages offered by EECo Time Code Generators! Frequency stability, 3 parts in 10^8, based on extremely stable crystal oscillator. 100% plug-in circuits to keep generator working for you day in and day out. Emitter-follower low-impedance outputs for long-distance transmission. Wider operating-temperature stability. Operable from aircraft power. Provision for external frequency standard. Human-engineered. Check it all out and you must choose EECo!

ZA-801 BCD OUTPUT (24-BIT)
Time-of-day code output (24-hour recycling) and any 2 of 8 pulse rates. $7,500
ZA-803 BCD OUTPUT (20-BIT) $7,500



ZA-802 BINARY OUTPUT (17-BIT)
Time-of-day code output (24-hour recycling) and any 2 of 8 pulse rates. $7,000



ZA-810 100 PPS CODE (36-BIT)
ZA-810-M1 IRIG TYPE C (23-BIT 2-PPS CODE)
Day-of-year plus time-of-day. Proposed Inter-Range Instrumentation Group formats. ZA-810 used by NBS on WWV. Either model, $10,100

SEND FOR TIME CODE GENERATOR FILE 301

Electronic Engineering Company of California
1601 East Chestnut Avenue • Santa Ana, California • Kimberly 7-5501 • TWX: S ANA 5263
EE 0-14

EXPLOSION-PROOF AXIALVANE BLOWER MOTOR

This thermally protected, explosion-proof induction motor drives an Axialvane blower unit. Unit features high output to weight ratio, develops 12.4 horsepower and measures 5½" diameter x 5⅞" long. Motor conforms with the requirements of MIL-M-7969A and has been environmentally tested to conform with MIL-E-5272A per Procedure I. These Model F-25-2 motors are produced by Kearfott's subsidiary, the Hertner Electric Company.

KEARFOTT DIVISION
Little Falls, New Jersey
GENERAL PRECISION, INC.
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zero plus
...and Carlson special stainless steels withstand the extremes of another launching
When a missile "lifts off," Carlson special stainless steel plates help launch it into space. These plates are the high strength, precipitation-hardening grades: 17-4 PH, 17-7 PH, and PH 15-7 Mo*. And there are sound reasons why these grades are used.
With these PH grades it is easier to attain the high physical properties and resistance to elevated temperatures required in space flight engineering. Simplified low temperature heat treatment will develop a Rockwell hardness of C40 to C50. Tensile strengths range from 180,000 to 220,000 psi in plates.
For applications where high strength at high temperatures and ease of fabrication are important, get plates in these grades from Carlson. We will be glad to work with you on specific applications.
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Photo of Atlas Missile courtesy CONVAIR ASTRONAUTICS, A Division of General Dynamics Corp.

been made at frequencies from 60 cps. to 500 kc.

▶ **Wideband Traveling Wave Tube**—A periodically focused traveling wave amplifier design which shows promise of providing bandwidths up to 60% at any frequency from L-band to K-band was described by three Hughes Aircraft scientists: R. W. Bagi, William Hant and M. V. Kreismanis. Experimental tube has achieved 30% bandwidth with power output in excess of several kilowatts and 43 db. gain. With liquid cooling, duty cycles up to 10% are possible using gridded electron guns, or up to 25% with a cathode pulsed gun, authors reported. Tube employs rugged metal-ceramic construction, permitting its use in airborne applications.

▶ **High-Speed Analog-Digital Converter**—An electron beam tube which can be used to convert analog voltages into eight-digit binary output at sampling rates up to 10 mc., was reported by M. H. Crowell and R. W. Sears of Bell Telephone Laboratories. Tube uses a ribbon electron beam which is electrostatically deflected by input analog voltage. Beam impinges on a code plate containing eight columns of holes which correspond to binary equivalent of the analog input voltage. Output collector electrodes, one for each digit column, produce output currents of 50 microamperes in parallel.

▶ **High Power Microwave Duplexer**—An S-band duplexer which can switch seven megawatts of incident peak power, with low noise and short recovery time of the order of an RF cycle, was reported by Dr. M. P. Forrer of General Electric's Microwave Laboratory. In new duplexer, switching is accomplished by secondary electron resonance instead of the previously used gas discharge principle. Forrer reported that new duplexers have been operated for over 1,100 hr. without signs of degraded performance, considerably longer than lifetime of conventional duplexers. Units can be built for frequencies between UHF and X-band, with bandwidths of 1%, which are tunable over 10% of band.

▶ **Increased Maser Gain-Bandwidth**—Experiments that confirm earlier advanced theory that the negative inductance and capacitance of a solid-state maser can be advantageously used to increase the gain-bandwidth product of a coupled cavity maser were reported by F. E. Goodwin of Hughes Research Laboratories. A ruby maser operated at X-band in push-pull mode with a magnetic "Q" of 80, with a gain-bandwidth product of 100 mc. for conventional

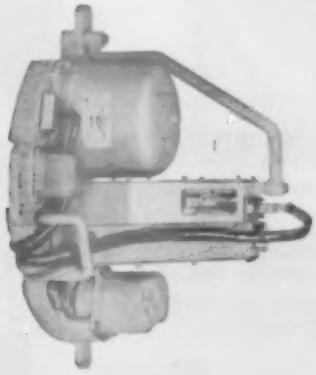
KEARFOTT engineered

and now produces

the stabilized

phase follow-up system

for Talos



Engineers: *Kearfott offers challenging opportunities in advanced component and system development*

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Little Falls, New Jersey

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LONG RANGE INPUT/1794/

News of the recapture of Condé from the Austrians was sped to the French Revolutionary Convention at Paris in a matter of minutes via Claude Chappe's amazing télégraphe aérienne, or relay aerial telegraph, Sept. 1, 1794. A new era in rapid communications had begun. / Today, instantaneous and completely reliable Electronic Communications insure the immediate and continuous interchange of intelligence throughout the Free World. ECI is proud of its initiative and responsibilities in the design, development and manufacture of high precision electronic equipment to the critical specifications required in various aerospace and surface roles vital to our National Defense and to scientific achievement. An example is ALRI—Airborne Long Range Input—a program where ECI communications and data link equipment fill an integral and essential requirement in linking USAF's advanced early warning system to SAGE—our continental defense network.

System Development
Communications
Data Link
Countermeasures
Computers
Actuators

ELECTRONIC COMMUNICATIONS, INC.
ST. PETERSBURG, FLORIDA

RESEARCH DIVISION
Timonium (Baltimore), Maryland

ADVANCED TECHNOLOGY CORPORATION (ADTEC)
Santa Barbara, California

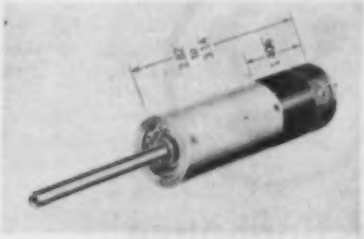
REGIONAL OFFICES: Washington, D.C., Teterboro, N.J., Boston, Mass., Dayton, O., Dallas, Tex., No. Hollywood, Calif.

single-cavity operation, showed gain-bandwidths of 250, 450 and 1,000 mc. for amplifier gains of 20, 30 and 40 db., respectively, when two active coupled cavities were used in a one-port maser, Goodwin reported. When applied to traveling-wave maser, the conventional 50 mc. gain-bandwidth can be increased to 150 mc. by using two cavities. With four cavities, the passband exceeds the ruby line width and typical traveling-wave maser characteristics were observed. Using six cavities and a structure passband of 200 mc. centered at 9,200 mc., a gain of 26 db. and an amplification bandwidth of 25 mc. were obtained. Ruby was cooled to bath temperature of 4.2K for tests.

NEW AVIONIC PRODUCTS

• **Tape-programed harness analyzer,** Model 230, checks cable harnesses for continuity, leakage from wire under test to all other wires, and short circuits. Analyzer provides automatic print-out to indicate short circuit and leakage identification to all points, crossed wire identification and branch circuit identification. Analyzer in basic configuration can handle 600 wires (1,200 points), or can be expanded to 9,600 wire capacity. Manufacturer: California Technical Industries, 1421 Old County Road, Belmont, Calif.

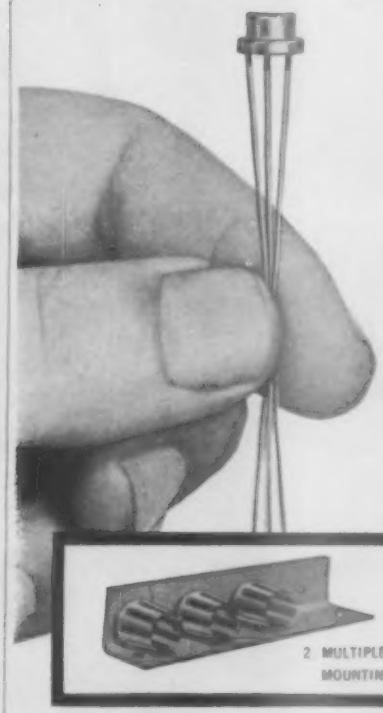
• **Ultra-high-g motor/tach generator,** designed to withstand 8,000g avial shock and 500g transverse shock, is available



IERC TRANSISTOR HEAT DISSIPATOR

actual size

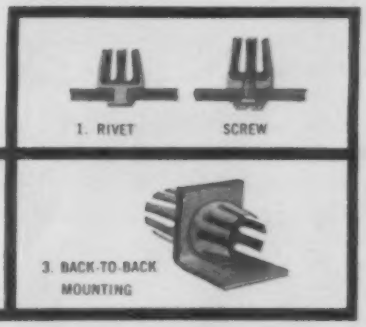
accepts .305 to .335 variations in TO-5 cases!



IERC Transistor Heat-dissipating Retainers readily accommodate diameter variations up to .030" found in TO-5, TO-9, TO-11, TO-39 transistor cases. This single IERC part saves you time and costs in specifying, stocking and application.

IERC's exclusive design features maximum thermal contact with transistor case for efficient transfer of heat to the dissipator and heat sink. Attaching methods suitable for printed circuit boards, chassis and heat sinks provide thermal benefits and retention in extreme shock and vibration environments.

Installation is a smooth, tension fit—eliminating the possibility of "snap-fit" impact injuries to the transistor!



Simplified installation for effective heat dissipation with IERC Transistor Heat Dissipators are illustrated: 1. Parts available in rivet or screw attaching types. 2. Single or multiple mounting on heat sink angle. 3. Back-to-back mounting.

Detailed information, performance graphs, etc. are available in latest IERC Technical Bulletin. Write for a copy today!

IERC DIVISION

INTERNATIONAL ELECTRONIC RESEARCH CORPORATION
135 West Magnolia Boulevard, Burbank, California

Foreign Manufacturers: Europelec, Paris, France. Garrard Mfg. & Eng. Co., Ltd., Swindon, England.

WESTINGHOUSE CAPABILITIES FOR DEFENSE

Westinghouse Electric Corporation continues to make significant advances in computer science with the versatile new WDP-167 airborne digital computer. This computer performs 167,000 mathematical operations per second. Each operation includes two memory cycle times plus arithmetic execution time.

The surprisingly small WDP-400 computer, now in development, will perform 400,000 operations per second.

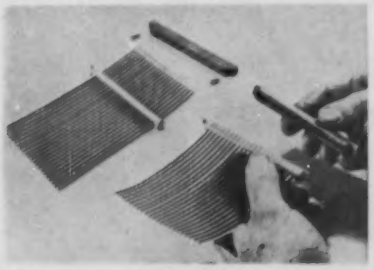
Both are general purpose computers for advanced applications in such fields as radar detection, defensive systems, space guidance, satellite tracking, missile and fire control.

Backed by years of experience in the military computer field, these developments at Air Arm Division are another important factor in Westinghouse *capabilities for defense. You can be sure . . . if it's Westinghouse.*

J-02323

Westinghouse

in size 9 permanent magnet motor or d.c. tach generator with extremely linear output. Motor, Type 9001-00, measures ⅞ in. diameter, provides virtually no change in speed over temperature range of −67F to 167F, according to manufacturer. Motor is available with gear train ratios of 6:1 to 46,656:1. Motor can handle up to 500 oz.-in. peak loads. Manufacturer: John Oster Manuf. Co., Avionic Div., Racine, Wis.



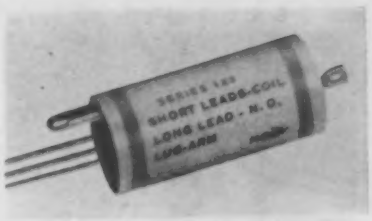
• **Contour multiconductor** cable only 12 mils thick and accompanying connector devices for use as interconnecting cables, in rotary joint connection and in movable rack and panel drawer connections. The flexible cable is available in different materials for temperatures from −65 to 250C. Up to 54 conductors per inch can be assembled in a single cable for microminiaturization applications. Hughes Aircraft Co., Industrial Systems Division, International Airport Station, P. O. Box 90904, Los Angeles 45, Calif.

• **Trimmer potentiometer,** Model 550, can withstand environmental extremes set by MIL-R-27208, operate at temperatures up to 200C and is protected against humidity and corrosion by isolating seal. Pot is rated at one watt and has 6 in. Teflon covered wire leads. Resistance range is 10 ohms to 50 kilohms. Manufacturer: Handley, Inc., 12960 Panama St., Los Angeles 66, Calif.

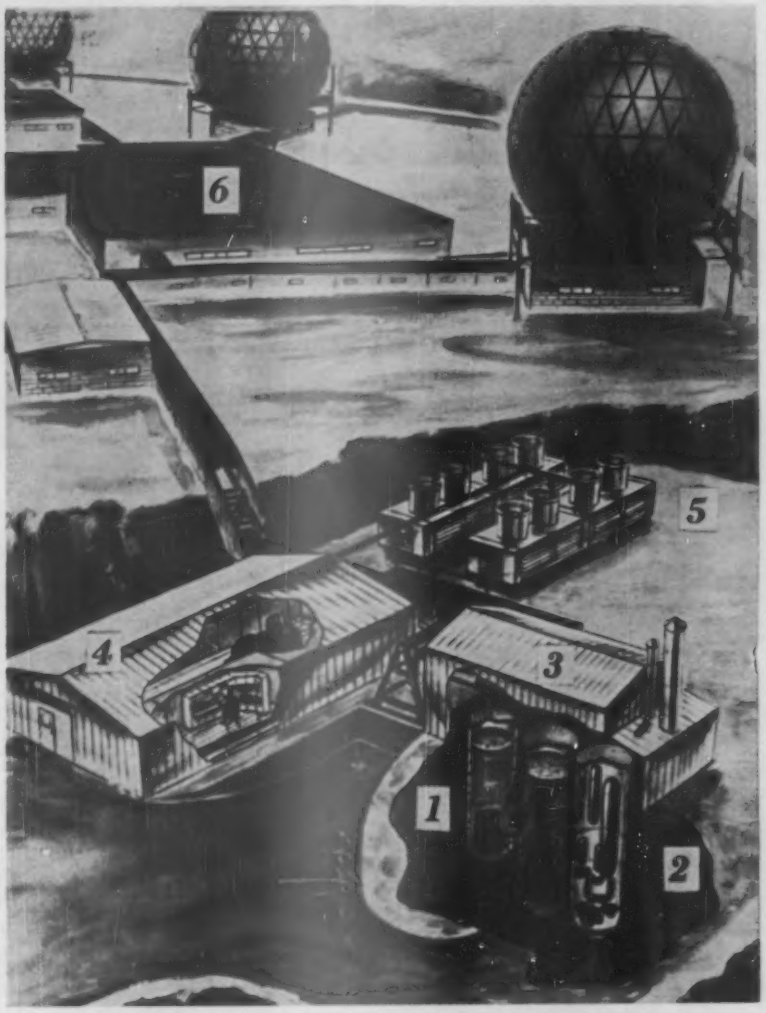
• **High temperature, microwave absorber,** permeable dielectric type CMA-701, can operate up to 800C with no detachable change in electrical or physical characteristics. Dielectric constant is 50 at frequency of 20 mc. Material provides more than 38 db./cm. attenuation at 8,200 mc., or 26 db./cm. at 10,000 mc., has a density of 4.05, can be machined or molded. Manufacturer: Custom Components Inc., Caldwell, N. J.

• **Backward diodes** for use with tunnel diodes in logic and other computer circuits, in low level rectifier and detector circuits. Leakage current is 400 millivolts and forward voltage is at 15% of companion tunnel diode's peak current. Forward voltage drop is guaranteed not to exceed 30 millivolts, typical shunt capacitance is 3 picofarads. Application notes containing tunnel diode and backward diode circuit designs can be obtained from the manufacturer: Transitron Electronic Corp., 168 Albion St., Wakefield, Mass.

• **Tubular high-g relay,** Series 123, reportedly can withstand vibration of 10g to 2,000 cps. and shock of 30g when deenergized or 100g when energized with no contact opening. The hermetically sealed relay, measuring ⅜ in. in diameter by 1¼ in. long, has contacts rated at 2 amps. for either 115 vac. or 24 vdc. for 30,000 operations, or one amp. for 1½ million operations. Leads are designed for printed board mounting. Operate time is 5 milliseconds and release time is 7 ms. Relay meets MIL-R-5757C and MIL-R-25018, according to manufacturer: Wheelock Signals, Inc., Long Branch, N. J.



• **Broadband video detector,** Type MA-441, for high tangential sensitivity receiver use over the 40,000 to 75,000



First Nuclear-Powered Radar Installation

Nation's first nuclear-powered radar installation, to be constructed for Air Defense Command atop 6,600-ft.-high Warren Peak near Sundance, Wyo., will generate 1,000 kw. of electric power and supply steam for heating facilities. The Martin Co. is responsible for design and construction of nuclear powerplant. Key elements in the installation include: (1) two uranium core chambers, 30 ft. high, dug into mountainside, (2) heat transfer cylinder for producing steam from water circulating through core, (3) maintenance building, (4) turbine generator, (5) turbine condensers, and (6) radar operations building. Facility is scheduled to become operational by May 1962.

"I'm wearing a Seiscor TELEPATH two-way radio. It gives me command of the *complete* operation *all the time* – it can do the same for you!"

The TELEPATH Miniature Two-Way Radio is one of many products engineered by Seiscor for short-range communications. Other products include: TELEPATH unit in a hard-hat, pocket-size 2-way radios, supervisory control stations, industrial wired communications units, units in special clothing (fire-fighters, etc.)

Seiscor manufactures, or can develope a complete short-range communications system for your needs. WRITE TODAY for Communications Requirements Data Sheet.

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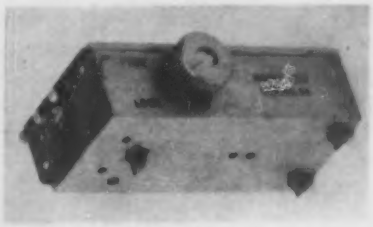
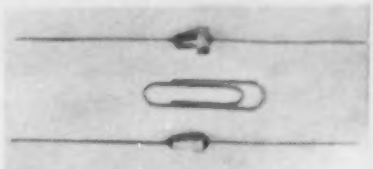
BOX 1590 TULSA, OKLAHOMA

mc. frequency range, has minimum sensitivity of −27 dbm. over entire frequency range for receiver bandwidth of 2.5 mc. and 100 kc. low frequency cutoff. No external holder is required, with connections provided for several types of waveguide. Manufacturer: Microwave Associates, Inc., South Ave., Burlington, Mass.



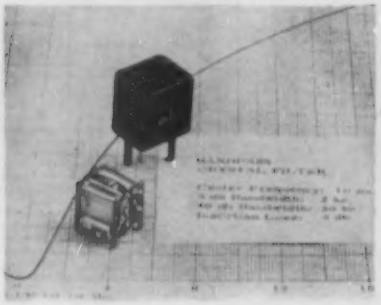
• **Strain gage,** Model SG2, also available with complementing portable bridge control readout, Model BCR1-O. The unbonded strain gage has strain range of ±0.003 in./in., gage length of 1.25 in., weighs approximately 1 oz. and measures 1.77 x 1 x 0.62 in. Gage provides infinite resolution with combined nonlinearity and hysteresis error of less than ±1% of full scale. Statham Instruments, Inc., 12401 W. Olympic Blvd., Los Angeles 64, Calif.

• **Miniature feed-through capacitor,** offering high thermal shock resistance, rated at 200 vdc. over temperature range of −55C to 150C., is available in electro-tinned brass case in three capaci-



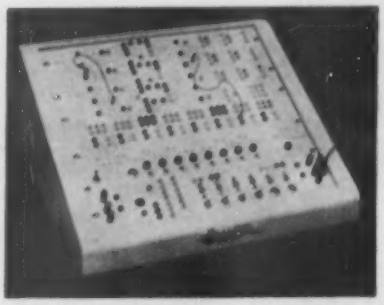
tance values: 820, 1,000 and 1,200 mmfd. Application data is available from manufacturer: King Electronics, Inc., 915 Meridian Ave., South Pasadena, Calif.

• **High temperature voltage reference,** Series 260, operates from unregulated 26.5 vdc., provides output of 5.8 or 8.5 vdc., with regulation of 0.005% for a 10% line voltage change. Temperature coefficient is quoted at 0.001% per degree centigrade from −55C to 150C. Device can provide one milliamp output current. Voltage reference is packaged in miniature crystal case, measuring ⅜ x ¾ x ¾ in. for installation in miniature relay sockets. All semiconductor elements used are silicon. Manufacturer: Viking Industries, Inc., 21343 Roscoe Blvd., Canoga Park, Calif.



• **Miniature crystal filter,** with volume of less than one-half cubic inch, has a center frequency of 10 mc., with 2 kc. bandwidth at 3 db. point and 20 kc. at 40 db. Insertion loss is 3 db. Devices are available with center frequencies of 10 kc. to 85 mc. Manufacturer: Electronic Laboratories Corp., 4221 Spencer St., Torrance, Calif.

• **Germanium tunnel** with peak currents of 1 ma. or 5 ma., peak current tolerances of 2%, 5% or 10% and peak-to-valley ratios of 8:1 are now available for operation over temperature range of −55C to 100C. Capacitance is six picofarad per milliampere. Manufacturer: Transitron Electronic Corp., 168 Albion St., Wakefield, Mass.



• **Digital logic trainer,** Type TDC, for instructing in digital circuit operation or breadboarding logic design, contains 50 prewired digital circuits with logical symbols identifying input-output connections and their function. Epsco, Inc., Components Division, 275 Mass. Ave., Cambridge 39, Mass.

NEW DEPARTURES IN MINIATURE

ULTRA-CLEAN INCUBATORS FOR M/I* BALL BEARINGS

N/D'S NEW WHITE ROOM PROVIDES ULTRA-CLEAN ENVIRONMENT FOR M/I BALL BEARING ASSEMBLY

N/D announces a new White Room at Sandusky, Ohio incorporating the latest technological advances available today. This new room provides a virtually dust-free atmosphere so necessary for the production of Miniature and Instrument Ball Bearings of high reliability.

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You can benefit from New Departure's 25 years of experience in M/I ball bearing production by calling your nearby N/D Sales Engineer. Or write Department L.S., New Departure, Division of General Motors Corporation, Bristol, Conn.

*Miniature and Instrument Ball Bearings.

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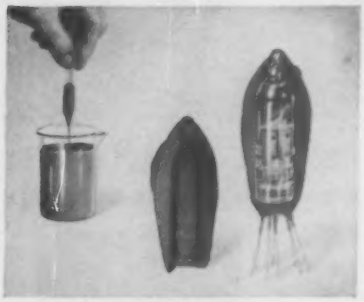
NEW DEPARTURE
MINIATURE AND INSTRUMENT BALL BEARINGS

General Electric Silicone Rubber finds dozens of uses in missile systems. How many more will prove vital?

General Electric silicone rubber has the "thermal toughness" to stand up under the searing heat of rocket blast-off or possible atomic attack. Add very good electrical properties and excellent resistance to aging, weathering, moisture, flame, ozone and corona and you can easily see why silicone rubber is now being used in virtually every U.S. missile and space vehicle.

Since both space technology and silicone rubber are relatively new, General Electric believes there are many more areas not yet explored where silicone rubbers can help keep a missile functionally reliable and combat-ready. To help designers in their evaluation work, we list here the principal properties and applications of G-E silicone rubber.



RTV LIQUID SILICONE RUBBER — One of the most versatile materials developed in recent years, RTV is a liquid rubber that cures at room temperatures. Like all silicone rubber, it remains flexible over a wide temperature range and is virtually ageless. Since it comes in a wide range of viscosities, it can be poured, sprayed, dipped, painted or applied with a pressure gun or spatula. It bonds tightly to metal when a primer is used. When not primed, you can readily remove RTV and then reapply more. You can impregnate tightly wound coils with RTV or form sections several inches thick.

You can control cure time from two minutes to 24 hours. These are RTV's typical properties:

Viscosity	from 120 poises (very pourable) to 12,000 poises (paste)
Specific Gravity	1.2 to 1.5
Solids Content	100%
Shrinkage	0.2%
Heat Resistance	from −90°F to 600°F, and as thermal insulation, in 5500°F flame for minutes
Ozone Resistance	Comparable to Mica
Electrical Properties	See last table

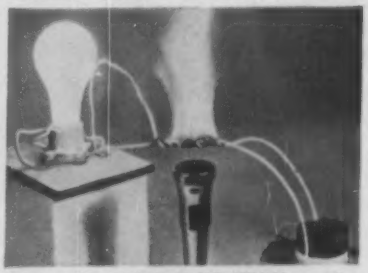
Applications—RTV is used as a high temperature structural sealant in missiles, satellites and space vehicles. It is used to pot and encapsulate electronic components and assemblies for electrical and heat insulation and for protecting delicate components from physical damage. It is commonly used as an impregnating insulation in transformer coils, to pot and hold cable in raceways and to pot cable breakouts. You can make flexible molds with RTV and hence make accurate, duplicate castings from originals.

RTV is an excellent thermal barrier and as such is applied on and around missile nozzles. Tests show RTV's resistance to flame temperatures as high as 5500°F for several minutes. RTV also functions as a flexible ablative material and is used around probe holes, along raceways, and between stages and structural joints on the missile skin.

HEAT CURED SILICONE RUBBER PARTS —Silicone rubber gaskets, port seals, O-rings, shock mounts and other mechanical parts are not only used on missiles but have wide application in ground support equipment. For instance, missile silo doors use silicone rubber seals that will stand up to outside weathering, ozone and abuse for years and which will also resist the heat of missile launching and nuclear attack. Silicone rubber also resists brief exposure to cryogenic materials.

Silicone rubber has long-lasting temperature resistance from −150°F to 600°F, with excellent electrical, weathering, ozone, corona, radiation and nonaging properties at these temperatures. High tensile strength and low compression set are also within its range of desirable properties:

Tensile Strength, psi	800—1500
Elongation, %	100—600
Hardness Durometer (Shore A)	25—80
Compression Set, %	10—80
Tear Resistance lb/in	40—200
Radiation Resistance	1×10^8 roentgens
Electrical Properties	See table below



WIRE AND CABLE INSULATION — The long term reliability of silicone rubber when operating in high ambient temperatures and when current over-loads cause the conductor to approach 500°F is an important feature of silicone insulation. In an 1800°F flame, specially constructed silicone rubber insulated cables will continue to insulate for hours, forming a non-conductive ash that gives off no toxic fumes. And short term reliability is obtained even when silicone rubber is exposed momentarily to a direct flame of 5500°F.

Because of this excellent heat resistance, more current can be carried than in conventional cable (or smaller cable can be used). Other features: best compression set of all elastomers at temperature extremes, so that silicone rubber wire and cable does not deform under clamps; high ozone, corona, radiation and weather resistance, low moisture absorption, flexibility down to −100°C. These are the typical properties:

Volume Resistivity	10^{15}—10^{16}
Dielectric Strength, volts/mil	600—450
Dielectric Constant, 60 cps	3.0
Power Factor	.0010—.0050
Radiation Resistance	1×10^8 roentgens
Physical properties	Similar to table above.

Applications—Wiring harness made of silicone rubber insulation is often found throughout missiles. Cable offers added reliability for use in various places throughout the launch complex below ground from power plant to silos. All combat vessels built for the U.S. Navy during the last ten years, including fleet ballistic missile submarines and the new nuclear-powered cruiser and aircraft carrier, have silicone rubber insulated cable installations in all fixed wireways. In every case, silicone rubber is chosen because it is virtually non-aging, stands up to intense heat better than any other flexible insulating material, and continues to operate even when subjected to fire.

●

There are many more places where G-E silicone rubbers' inherent properties can be vital in missiles, satellites and space vehicles. For further data, call your nearest G-E sales office or write Section J1133, **Silicone Products Department, General Electric Company, Waterford, New York.**

Progress Is Our Most Important Product

GENERAL ELECTRIC

Control Center Guides Orbiting Satellites

By George Alexander

Operating as a space traffic control tower, the USAF Satellite Control Center (SCC), Sunnyvale, Calif., will direct all Discoverer, Midas and Samos satellites through data flow and display systems now installed and functioning at the facility.

With these systems, designed and developed by Radiation, Inc., Melbourne, Fla., under subcontract to Lockheed, the SCC (AW May 30, p. 57) will be able to handle 20 to 30 satellites in orbits ranging from 300 to 500 mi. and with periods of approximately 90 to 105 min.

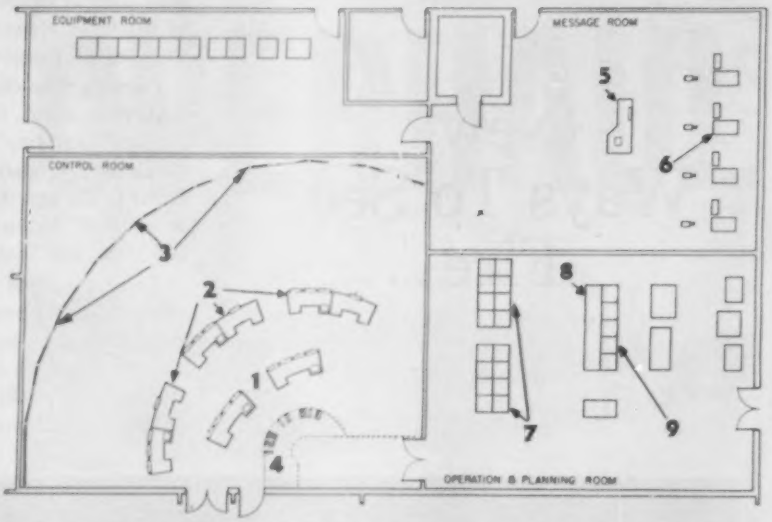
Problem of control is complex, but the Radiation, Inc., systems will provide SCC with the capability of sorting out and organizing the passes of several satellites over a tracking station within the same short time period, so that an orderly arrangement of transmission and reception of signals to overhead vehicles may be effected.

Focal point of the SCC and of Radiation's systems is the control room, where all data on the orbiting satellites will be displayed on TV monitors, static and dynamic projection screens, numeric readout tubes, charts and maps.

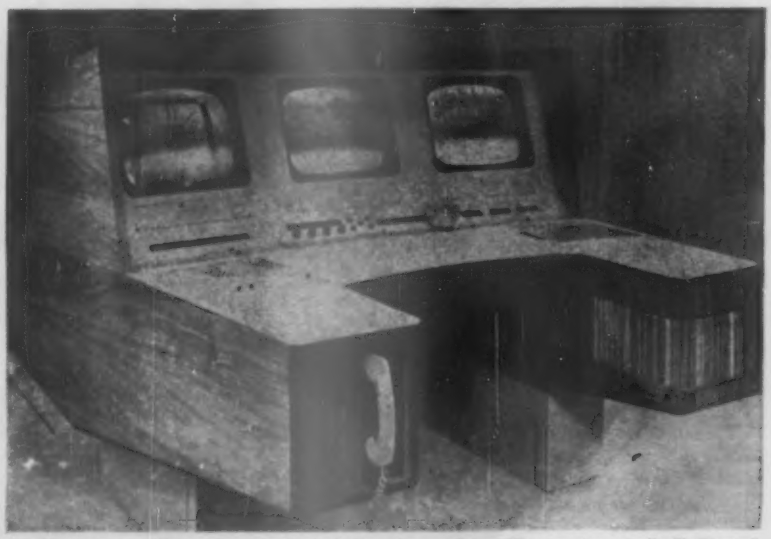
Present arrangement of the control room is still in the research and development phase, with several combinations of men and equipment being studied. Initially, USAF, Lockheed and Radiation are considering a "one team per satellite system" arrangement, which would place all Discoverers under control of one team, all Midas under a second team and all Samos under a third.

Each team consists of an assistant test director and an assistant test controller, manning side by side consoles. Over-all responsibility of the control room and of the three satellite systems is charged to a test director, aided by a test controller, both sitting at identical master consoles. (Job titles are R&D designations and may be changed when fully staffed by USAF personnel. Contractor personnel now fill the test controller and assistant test controller slots as instructors.)

Presumably, when a series of Discoverer, Midas and Samos satellites are in orbit, each team will maintain cognizance of the location of every vehicle under its control, but will concentrate on that particular satellite which is in position to transmit and/or receive in-



FLOOR PLAN of the USAF Satellite Control Center shows the control room with test director and test controller master consoles (1); assistant director-controller team consoles (2); eight static and dynamic projection screens (3); and projector booth, containing 28 static and dynamic projectors (4). Message dispatcher console (5), teletypes, their TV cameras and monitors (6) are located in the message room. Operations and planning room contains the 16 status boards (7); the tape punch flexowriter (8); and the dynamic plot generators (9). Camera control units, TV monitors and master timing unit are housed in the equipment room. This drawing illustrates an early floor plan, showing a total of 10 projection screens and 15 projectors.



ASSISTANT test director's console includes three 17-in. TV monitors and all controls necessary to select and display information from data flow and display systems developed by Radiation, Inc. Black bars beneath TV monitors are time display tubes. Button panel at left of console controls communications links. Slate at right of console is a translucent panel with TV camera underneath, upon which messages may be written and transmitted to other parts of the Satellite Control Center. Pneumatic lines and terminals are located beneath the center portion of the console.

New Ways To See Fire...

Fenwal has developed two advanced methods of finding fire or overheat faster in aircraft and missiles.

Fenwal's FIDO (Fire Inspection Device Optical) permits a pilot to *visually* monitor potential danger areas from a remotely located control panel. He merely looks into a tube containing FIDO's optically oriented glass fibers to *see* the hidden area. Or, FIDO can be used by launching crews to check out blind areas in missiles and rockets. *Image resolution is as fine as use demands!*

Fenwal's Surveillance Detector sees fire or overheat that may occur in large volumes, eliminating the "misses" that may be present when point or line detection is used. It operates photoelectrically and is sensitive either to the first flicker of a flame or to heat radiation. It is "blind" to daylight and even the direct rays of the sun — *it "sees" only the potential danger!*

These advanced Fenwal safety devices are the end products of long and continuing research. They complement Fenwal's established capabilities in unit and continuous detectors, and explosion suppression. A Fenwal engineer will gladly supply details. FENWAL INCORPORATED, 1212 Pleasant Street, Ashland, Massachusetts.

Another example of how

Fenwal DETECTS TEMPERATURE . . . PRECISELY

Soviet Rocket Chief

Marshal Kirill Semenovich Moskalenko has been appointed the new chief of the Soviet Rocket Command, succeeding Marshal Mitrofan I. Nedelin, who was killed in a recent airplane crash in the Soviet Union.

formation from the ground stations.

Information from tracking stations is funneled into the SCC by direct teletype, telephone voice lines and radio links, processed through computers, collected according to satellite system and then relayed to the appropriate team in the control room by closed-circuit TV, projection screens and pneumatic lines. The director-controller teams then analyze the data; decisions are made and commands sent to tracking stations for transmission to the satellites.

Since operational models of the Midas and Samos vehicles will be fitted with restartable Agena engines, some of the more important decisions that might be made will include changing satellite orbits for more flexible surveillance and grouping of several vehicles for either more comprehensive coverage of wide areas or greater detail on a specific object.

At his console, each director will find: three 17-in. closed-circuit TV monitors and controls; communications panels; time displays (including Greenwich

OPERATION OVERHAUL

Our choice for jet-engine pre-cleaning at Utica Division of Curtiss-Wright is Ferlon,® and here's why:

*by Dean E. Shiels**

"We needed an alkaline pre-cleaning solution that would remove stubborn soils, rust, resins, gums, tenacious carbon deposits, and lead deposits prior to removal of heavy heat scale and oxides from jet-engine parts. We wanted to reduce cycling time substantially, and extend the chemical life of more expensive solvents.

"Wyandotte FERLON has reduced cycling time on all parts, and cut the cost of subsequent solutions. It is an excellent rust remover for magnetic steel parts . . . has saved considerable labor in cleaning ferrous parts . . . and has shown no evidence of injury to parts processed. It has reduced rejects for improper cleaning to a minimum, and paid for itself many times over."

May we demonstrate these points to you? Call your Wyandotte representative, or write us direct.
Wyandotte Chemicals Corporation, Wyandotte, Michigan. Also Los Nietos, California; and Atlanta, Georgia. Offices in principal cities.

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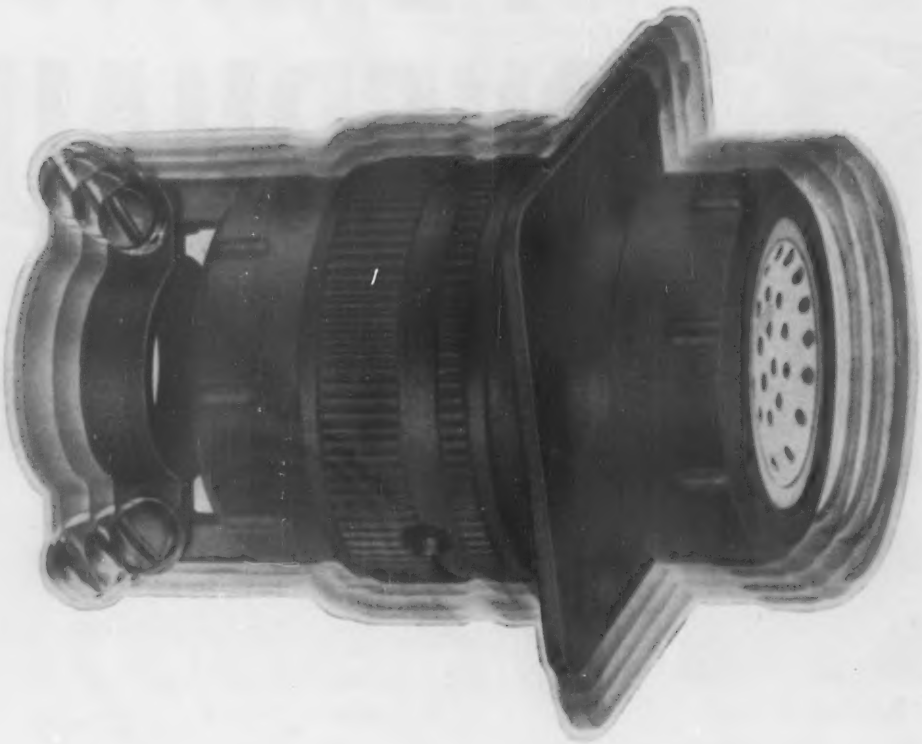

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Reliability for Industry · Aircraft · Space Vehicles Cannon's full line of vibration-proof plugs are engineered to meet the most stringent demands of industry, missiles, and aircraft. If you have a problem in vibration, let us provide the answer. From umbilical plugs to the most versatile subminiatures... for any ground or airborne use, Cannon vibration-proof plugs surpass what is expected of them. Another reason why you should always consult the first name in plugs...why you should consult Cannon for all your plug requirements. For information on these or other Cannon products write to:

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CANNON PLUGS

Mean Time, system, count-down and elapsed); dictaphone for recording and reporting messages; writing desk for transmission of messages over the TV circuit; and pneumatic lines and terminals for transmission and reception of messages.

The TV circuit, a high resolution 800-line system, joins the director's three console monitors to 16 status boards (located in the operation and planning room, adjacent to the control room) and four teletypes (located in the message room, also adjacent to the control room).

The status boards are essentially light-boxes, with TV cameras mounted in the bottom and trained upward. Charts, graphs and messages would be placed on the translucent panel tops of the cabinets and so picked up on the circuit. Of the 16 boards, four are assigned to each of the three satellite systems; the remaining four are to be used for such general data as weather, tracking station conditions, etc.

Four teletypes—one for each satellite system and one for general communications—are also covered by TV cameras. The machines are probably part of a net including the Air Force Ballistic Missile Division at Inglewood, the Pacific Missile Range headquarters at Pt. Mugu, and the launch blockhouses at Vandenberg AFB, all in California, the tracking stations and the downrange telemetry ships.

Eight large projection screens, forming a curve from diagonal corners of the control room, face the director-controller teams. Two—one static and one dynamic—are assigned to each team; the two end screens are to be used for such general purposes as systems control (to determine priorities of satellites over a tracking station), satellite schedules (to show which vehicles are coming up next), and for special problems encountered by any team which might call for an additional screen to display the conflict.

The static screens will depict the predicted orbital path (ephemeris) of the satellite and will be compared with the actual traces of the vehicles in real-time plots, as displayed on the dynamic screens. The static projectors, although similar to conventional commercial models, can superimpose multiple images of up to twelve colors on a single screen with a high degree of resolution.

The dynamic projectors are operated from tracking data received in the SCC from the ground stations. The data is first processed through a Control Data Corp. 1604 computer, extrapolated and the results read out on punched tape. The tape is then fed into a dynamic plot generator which translates the tape's binary code into the analog voltages necessary to drive the projectors.

In operation, the data flow and display systems would probably work like this: the actual real-time plot of the satellite, as traced by the dynamic projector, would be compared with the predicted ephemeris on the static projector screen. If deviation is noted, the director-controller team would issue corrective commands to the tracking station for transmission to the satellite. Simultaneously, the team would be checking the information on the status boards, via the closed-circuit TV loop, on tracking station readiness and conditions (equipment failure would have to be reported immediately, because of the short time intervals between passes of satellites), recovery force readiness (in the event of capsule recovery), weather, payload functioning and other status information.

If any discrepancy were noted between mission objectives and actual satellite performance, the director-controller teams would initiate corrective action immediately. Should the discrepancy be major—say, complete loss of vehicle power—it is probable that the team would have to reschedule the other vehicles of that system to cover the gap caused by that vehicle's loss, until such time as a replacement vehicle could be launched to take its place.

Although Discoverer is a research program, contrasted with the operational natures of Midas and Samos, it is assumed that these satellites are being incorporated into the SCC's program for both open-ended research (specifically, bioastronautics and the development of various space techniques) and ground personnel training purposes.

USAF Tests Space Food Warmer

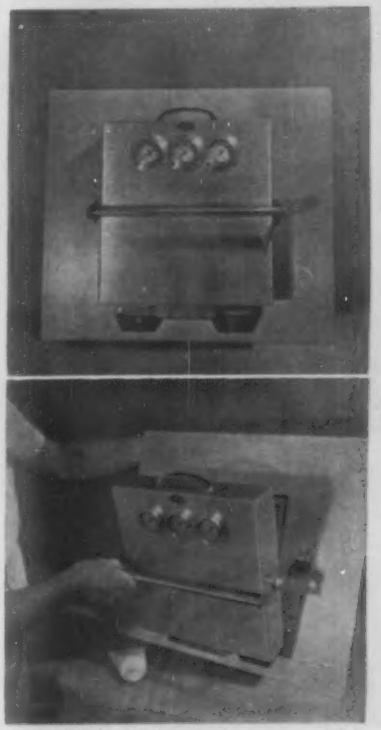
Mineola, N. Y.—Solar thermal radiation will constitute the sole heat source for a space vehicle food warmer now under evaluation by the Wright Air Development Division.

The solar space oven is the result of a WADD contract let to REF Industries, Mineola, N. Y., aircraft galley manufacturer, to develop an efficient food warming device that is independent of electrical power. Prior to this contract, the company developed an electronic oven used in Project Hermes (AW May 9, p. 95).

REF selected the solar-heated oven design after first investigating and discarding the possibility of chemical and nuclear powerplant heat exchanger methods. Excessive piping and shielding weight in the nuclear method and fumes and irreversibility of chemical reactions precluded the use of these heating techniques.

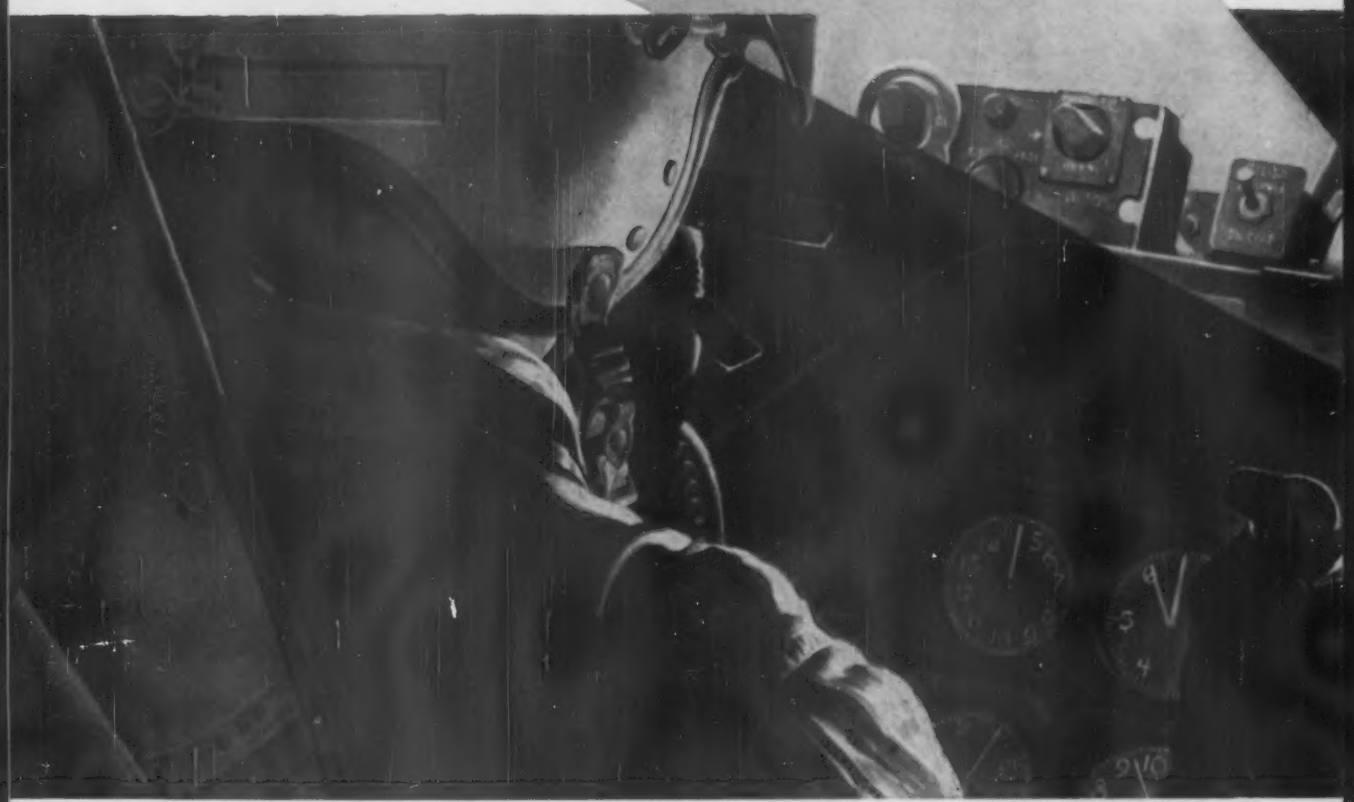
The capacity of the space oven is three tubes of semi-solid food concentrates. The Air Force says that heating is necessary both to make the food more palatable and to reduce the incidence of harmful bacteria.

The thermal radiation collection surface on the 14-lb. oven is a 2 sq. ft. magnesium plate. The magnesium oven is cast in two pieces for maximum thermal efficiency with the flanged collector surface on one side connected to the oven heating surface. The other side of the oven is a hinged magnesium door. This is designed to fit snugly against the mating surfaces, thus conducting the thermal energy to all sides of the food to be heated. The solar oven is designed to operate in a spatial orbit in the vicinity of the earth. The solar flux in the earth's outer atmosphere of about 440 Btu. per hr. per sq. ft. should bring the food warmer to an equilibrium temperature of about 450F. On a Mars



MAGNESIUM plate of solar space vehicle food warmer heats three tubes of food to 160F in 70 min.

HEDGEHOPPING AT MACH 1
Lockheed radar shows pilot how to miss what he can't see



When a pilot hugs the deck traveling a mile *every four seconds,* his route is the world's most dangerous obstacle course. Hills, bridges and other hazards can be in his lap before he has time to maneuver safely over them. He needs information well in advance, particularly in poor visibility or at night.

And now he gets it—from Lockheed Electronics terrain avoidance radar. A compact display shows him obstacles, his position in relation to them, and the maneuvers necessary to avoid them—in time.

Lockheed Electronics systems engineers have created in one group of modules the most versatile airborne radar in flight test today. Equally effective as a mapping, bombing or navigational radar, this lightweight, transistorized unit is typical of the sophisticated equipments developed by Lockheed Electronics to help strengthen the nation's defense.

CAPABILITIES—MILITARY SYSTEMS/STAVID DIVISION

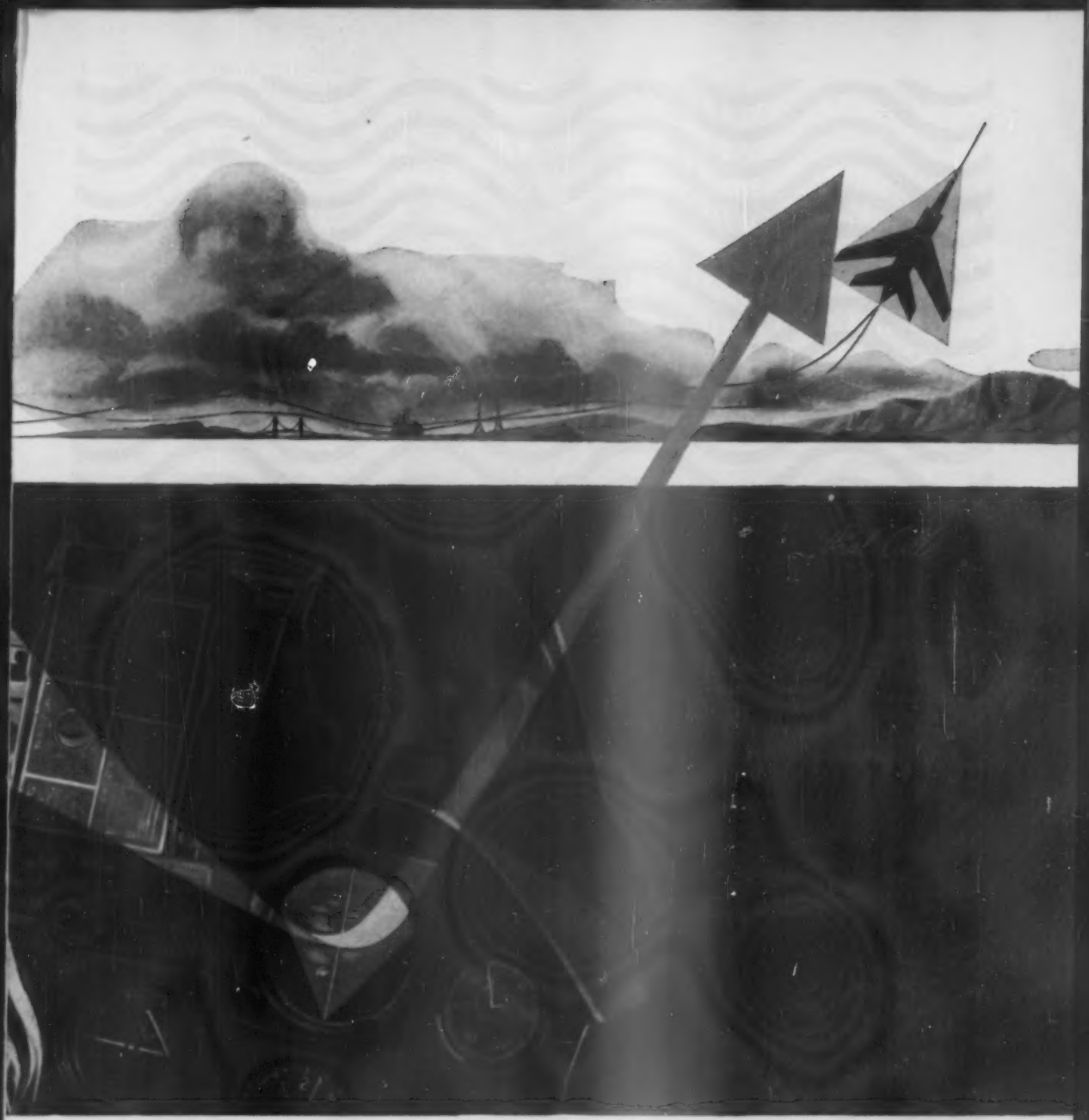
RADAR SYSTEMS—search, bombing, navigation devices and displays, missile guidance and control, automatic detection and data processing

COUNTERMEASURES—ECM, ECCM, active and passive

UNDERSEA WEAPON CONTROL AND DETECTION—ASW, electromagnetic detection, location and communication

SIMULATION AND TRAINING DEVICES

OPERATIONS ANALYSIS—offensive and defensive systems, war operations, undersea warfare, electronics in space



MINDING THE FUTURE

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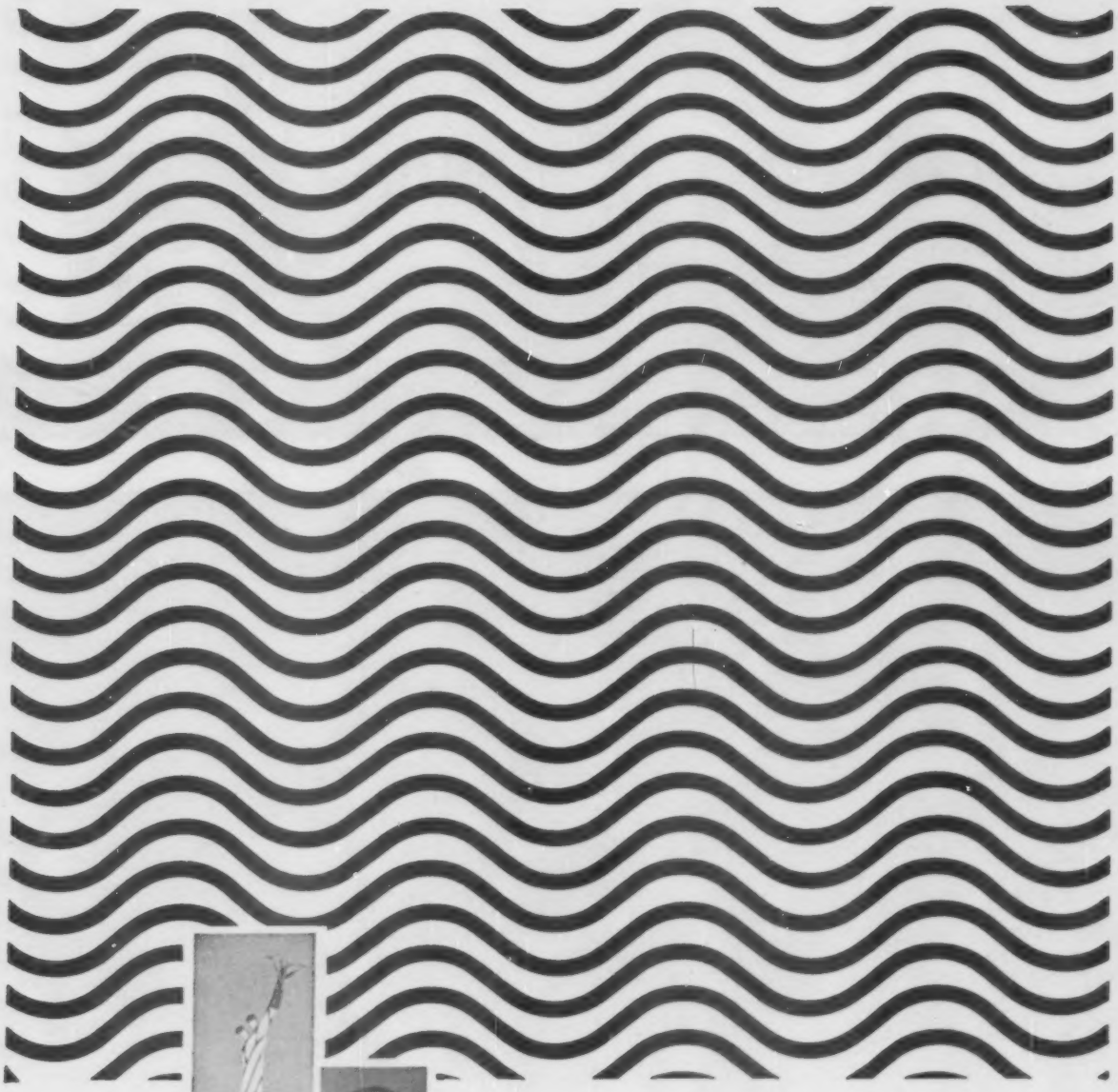

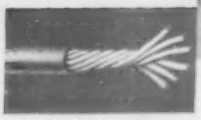

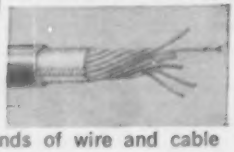

At Hitemp–Quality is not an illusion

The illustration above is a clever art illusion. The illusion of comparable quality that different brands of wire and cable give is also clever. To the naked eye, they seem identical.

Most brands of wire and cable may be produced with similar materials and equipment. One brand, however, will outlast, outperform the others — Hitemp.

The reason? Because Hitemp has the greatest store of experience in the industry—two modern production facilities that are second to none—and more than one-fourth of its entire work force devoted solely to inspection and quality control.

Hitemp products are for you, the wire and cable user who requires quality and reliability that is fact, not illusion.

Hitemp is a Division of Simplex Wire & Cable Co.

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mission (with 220 Btu. per hr. per sq ft. flux), the equilibrium temperature is 300F.

Baking time for the spaceman's food, in an earth orbit, will be approximately 70 min. from tube insertion until a palatable 160F temperature is obtained. Air Force requirements prohibiting the use of electricity will deprive the astronaut of light indications or automatic shutoff devices relied upon so heavily by housewives. In fact, the use of solar energy for heating prevented REF from meeting one WADD specification, that of providing an on-off control. The solar oven will operate unless the vehicle is rotated so that the collection surface is on the dark side.

One problem in utilizing direct solar energy for food warming is that the vehicle must be heliotropically oriented. A possible solution to this problem would be to mount three ovens 120 deg. apart about the space vehicle. This, however, would negate much of the weight advantages of the solar heat system.

The solar food warmer is equipped with the usual devices to permit operation in zero gravity conditions. Magnetic latches close the oven door and spring clips press the food tubes against the magnesium surfaces to permit conductive heating. The absence of convection currents under zero g conditions requires direct contact between the food tubes and the magnesium surfaces.

F-1 Turbopump Test Stand Nearly Complete

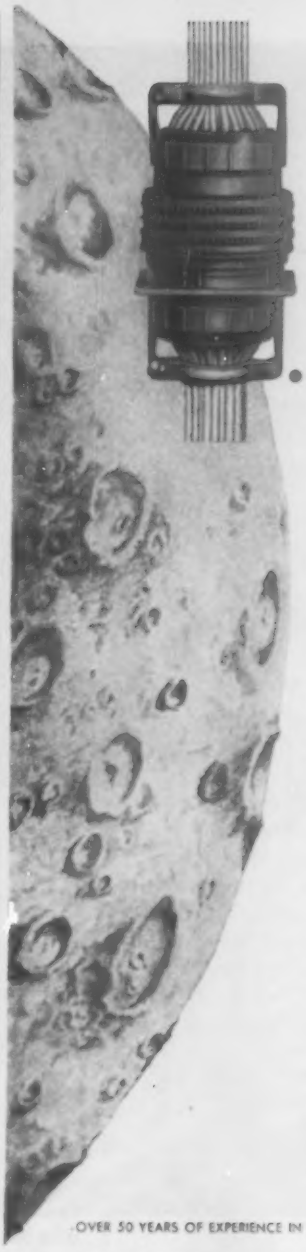
Los Angeles—Turbopump test stand for Rocketdyne's 1.5 million lb.-thrust F-1 rocket engine is near completion at North American Aviation's Santa Susanna Mountain facility. The stand is a modification of a former propulsion test stand and will be used for checking out turbopumps prior to installation on the F-1 engines for runs at Edwards AFB, Calif.

Designated Bravo II, the facility will have three test positions—one to be used for calibration, another for duration testing and the third for research and development. Normal frequency of testing will be five tests per 16 hr. day with a capability of increasing to eight tests per 16 hr. day.

Tankage installed on Bravo II includes two 20,000-gal. liquid oxygen vessels, one 30,000-gal. fuel vessel and a 20,000-gal. water tank.

The turbines on the turbopumps under test will be operated by a gas generator driven by propellants supplied from tanks other than those containing propellants for the turbopumps being tested.

Each of the three test positions on Bravo II has an afterburner to carry off gases generated by the tests.



NEW PYLE STAINLESS STEEL MIL-C-26500 CONNECTORS*

True Connector Reliability

Here is a miniature, lightweight connector so highly resistant to extremes of temperature, vibration and altitude that it provides, at last, *true connector reliability* for air, missile and space systems.

The stainless steel shell, exclusive with the Pyle-National connector . . . equals aluminum in weight with at least five times greater durability of wearing surfaces; has absolute corrosion resistance with no surface coating; maintains high strength at maximum operating temperatures.

* Qualification Approval Listing has been extended to Pyle-National under MIL-C-26500 (USAF). Write for complete information.

DESIGN CHARACTERISTICS

- Crimp type, removable, snap-in contacts to MIL-C-26636 securely seated and restrained by metal collet.
- Collets, fully protected against tool and shock damage, controlled against deflection.
- Rigid insert parts provide firm contact support, positive control of axial location and skew.
- Inserts factory bonded to shells. Wire sealing independent of cable clamp.

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OVER 50 YEARS OF EXPERIENCE IN THE MANUFACTURE OF ENVIRONMENTAL RESISTANT CONNECTORS

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. . . THERE'S ONE NEAR YOU

BUFFALO CHICAGO CINCINNATI DETROIT LOS ANGELES

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SERVING THE AIRCRAFT INDUSTRY FOR OVER 40 YEARS

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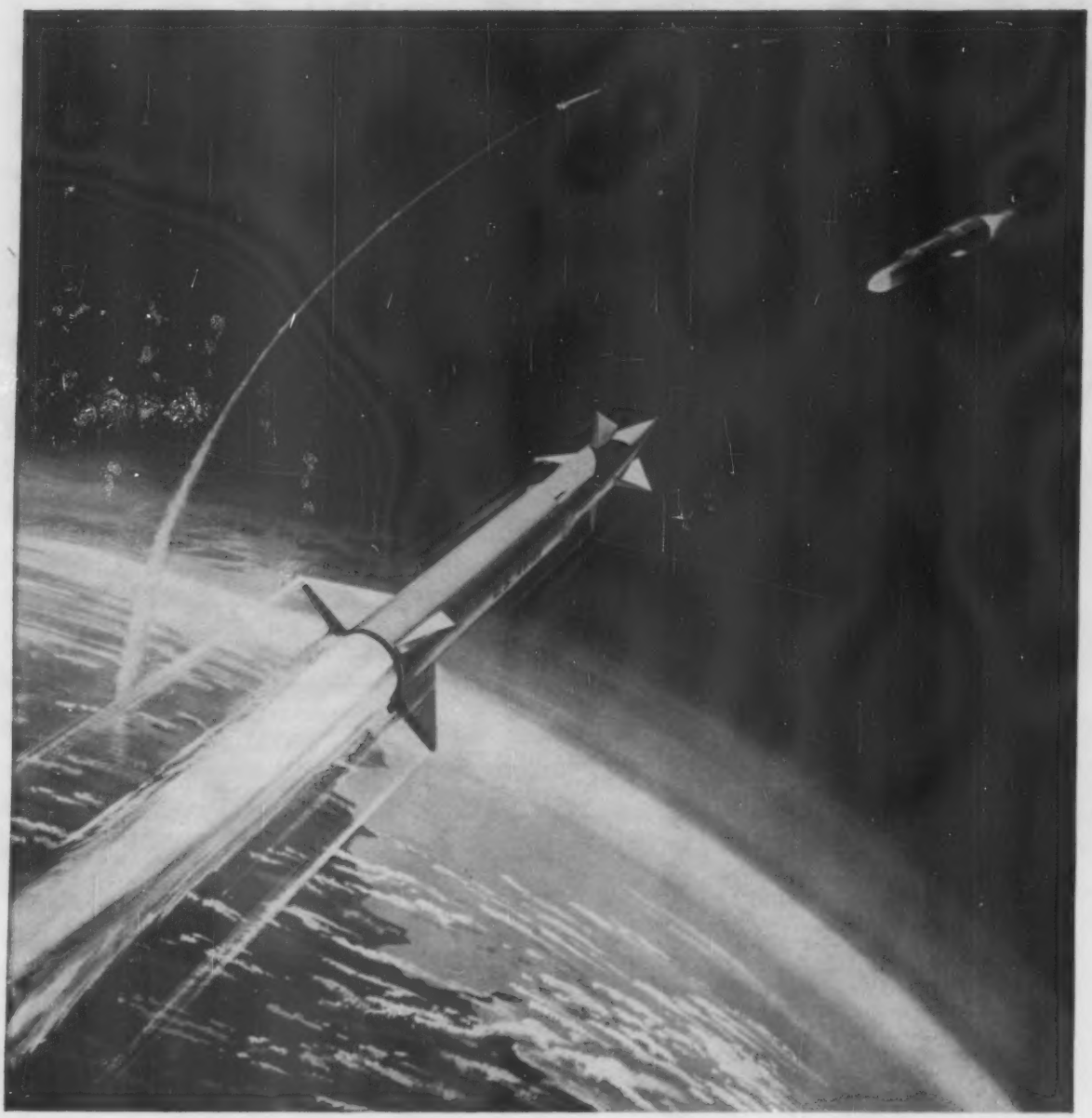

With its tremendous thrust, *Zeus* can intercept attacking missiles far from the area it defends

Zeus is designed for a hit every time on supersonic bull's-eyes!

At best, an anti-missile defense will have only a few minutes to react ...and no "second barrel" to fire at its supersonic target.

Nike Zeus needs none. Tests of this new anti-missile missile show that it will attack enemy ICBM's with 100% accuracy at a distant interception point. There its nuclear warhead will be detonated to blanket the approaching ICBM with an explosive curtain.

The newest member of the famous Douglas *Nike* family, *Zeus* was developed in a joint Western Electric, Bell Telephone, Douglas Aircraft project. Its design combines the most successful lessons learned from *Ajax* and *Hercules*—*Nike Zeus* predecessors that are on duty around many important U. S. cities and industrial centers and with NATO forces overseas.

DOUGLAS

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Army Tests Toxicity Of Boron Hydride Fuel

Tests carried out by the Army Chemical Warfare Laboratories show that high-energy boron hydride fuels and their boron oxide exhaust product produced toxic effects when applied to the skin and eyes of rabbits, rats, dogs and other animals.

The toxicity of these materials varied from one type of animal to the next. In rabbits, for example, boron oxide caused conjunctivitis and, applied to their wet backs, produced an erythema. In rats, when sprayed and applied topically for extended periods, the oxide led to significant changes in their urine. Boron hydride appears to be a serious health hazard to rats, guinea pigs, rabbits and cats when they are exposed to it orally, ocularly and cutaneously.

Dogs and rats, however, which inhaled boron oxide in aerosol form for periods up to 24 weeks showed no signs of poisoning or pneumoconiosis. The tests also showed that boron hydride can be effectively flushed from the skin of test animals with a mild solution of ammonia, and this flushing agent is considered suitable for humans that may come into contact with the fuel. Surgical glove material and silicone ointments offer only limited protection, according to the reports.

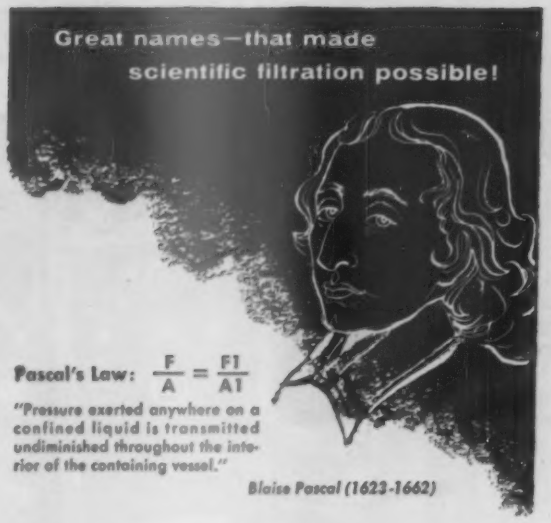
Two reports on the tests, PB 161771 and PB 161772, are available at 50 cents each from the Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C.

Arcas Rockets Study High Altitude Weather

Eglin AFB, Fla.—Series of 100 rocket space probes to study meteorological conditions between 100,000 and 250,000 ft. is being conducted here jointly by the USAF Air Proving Ground Center and Cambridge Research Laboratories, Bedford, Mass.

The Arcas research rockets, made by Atlantic Research Corp., Alexandria, Va., are carrying small transparent Mylar plastic balloons, manufactured by G. T. Schjeldahl, Northfield, Minn., called Robin (Rocket Balloon Instrument) (AW Oct. 17, p. 67). At the peak of the rocket's trajectory the nose cone is separated and the balloon inflates. The balloon, which carries collapsible radar reflectors internally, descends initially from peak altitudes at approximately 360 fps., slowing gradually as it enters denser air and at 100,000 ft. collapses from the atmosphere's increased pressure.

Ground radars plot its course during descent to determine wind direction, atmosphere density and temperature.

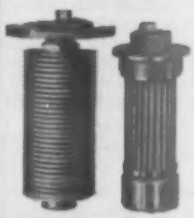

Great names—that made
scientific filtration possible!
Pascal's Law: F/A = F1/A1
"Pressure exerted anywhere on a confined liquid is transmitted undiminished throughout the interior of the containing vessel."
Blaise Pascal (1623-1662)

Although Pascal's Law is more than 300 years old, it is still one of the basic principles that must be taken into consideration in the design of new products for modern industry. And Air-Maze engineers, in their specialized field of developing better methods of filtering liquids and gases, are ever conscious of the importance of Pascal's discoveries.

For 35 years, whatever the filtration requirements—hydraulic presses or jet aircraft, air compressors or vacuum pumps—Air-Maze has been at work keeping equipment running better and longer by keeping it clean and free from damaging contaminants.

The products shown below are representative of the many designed and developed by Air-Maze engineers to meet special filtration requirements. If your product involves any gas or liquid that moves, Air-Maze can help you.

High-pressure liquid filter currently used on jet engines and missiles.



Open circuit filters, either disc or pleated type, for installation in any available cavities. All-metal filtration media for high efficiency even at elevated temperatures. Available with or without housings.

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Exhaust Spark Arresters • Breather Filters
Oil Mist Eliminators

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A SUBSIDIARY OF ROCKWELL-STANDARD

Another ⋈ Test System at work...

Magnatest FW-400 performs as planned at CONVAIR/FORT WORTH, *a Division of General Dynamics. Here, working out the equipment, are (left to right) Wm. L. Bierwirth, Quality Control Engineer for Convair, Sam Vance and Jack Harrer, Field Engineer and Branch Manager for Magnaflux, and B. E. Justice, Convair Inspection Superintendent.*

Test Critical Tubing with Eddy Currents – 1/8" to 6" O.D. – Up to 600 ft./Min.

This Magnatest FW-400 eddy current test instrument is used for both research and production testing of critical stainless steel and aluminum tubing. Broad and multiple-purpose, it is just one of a variety of Magnatest units in use to test nonmagnetic tube, rod and wire—for seams, inclusions, voids, concentrated porosity, embrittled areas, slivers, laps, etc.

Eddy currents are induced in the material to report the defects to the detection 'scope and/or other readouts in the instruments. Full automatic feed and marking at mill speeds can be provided.

An FW-400 is as flexible as you need it to be! Modular panel design provides customized testing with little special engineering. Many installations start with only three panels: power supply, the oscilloscope and controls, and the frequency oscillator panel for the detection coil assembly. Depending upon your need, pen recorder, audible and visual alarms, automatic marking of defects and still other functions may be included or added later in simple, building-block fashion.

For full data phone our local Field Engineer, or write to Magnaflux Corporation, 7306 W. Lawrence Avenue, Chicago 31, Illinois.

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Furnas Discusses U. S. Space Planning

In a speech to the Eighth Annual Engineering Management Conference in Chicago, Ill., Dr. Clifford C. Furnas, former Assistant Secretary of Defense (Research & Development) outlined his views on U. S. space planning, its significance, and social and political forces on engineering management in the aerospace age. Because of its interest to industry, AVIATION WEEK *is reprinting his text in full.*

In the spring of 1955, a very secret committee of nine scientists and engineers was appointed to advise the Assistant Secretary of Defense for Research and Development on the technical feasibility and desirability of launching an instrument-carrying earth-satellite during the so-called Geophysical Year, which was to extend from Jan. 1, 1957, to June 30, 1958. I was a member of that committee.

There was a particular reason for such an evaluation at that time. A technical intelligence report had been presented to the National Security Council indicating that the Soviet Union was working assiduously on a satellite project and that there was a high probability that Russia would achieve success in the not distant future. It was anticipated that such a technological feat would be militarily important and have great propaganda and prestige value; hence the United States should give very serious consideration to a program pointed toward the successful launching of the first satellite before the Russians could steal a march.

This committee met several times and seriously considered all angles from the scientific and engineering points of view. It was felt that such a project on the part of the United States at that time would be a bit premature. Five years later would have been a more feasible time for proceeding in an orderly fashion. However, in view of the international situation, it was decided the project should go forward even though technical success at that early period was by no means assured. The decision was unanimous. Thus, it was international politics which was the decisive factor in what at first glance was an engineering matter.

Parenthetically, I should add that I was one of a trio on the committee which turned in a strong minority report questioning the wisdom of the rocket system which the majority recommended for putting up the first satellite. This minority was convinced that the booster system for the satellite should utilize the existing Army Redstone rocket rather than depend upon the development of a new rocket under a Navy contract in their proposed project Vanguard. As everyone knows, the Vanguard was the one that was selected. Later evidence proved that the minority opinion was, almost without question, the sounder one, at least as far as time schedule was concerned. Had the minority group's recommendation been followed, America would almost certainly have had a satellite in orbit before the Russians. It is interesting to speculate what the course of history might have been had that recommendation been followed. Certainly, many events in the last three years would have been very different—perhaps significantly so. This is not to say, necessarily, that the course of recent history would have been better for the United States but it almost certainly would have been different.

DR. CLIFFORD C. FURNAS

Dr. Clifford C. Furnas, former Assistant Secretary of Defense (Research & Development) is chancellor of the University of Buffalo. He was named to the Pentagon post by President Eisenhower on Nov. 22, 1955, to succeed Donald A. Quarles, who became Secretary of the Air Force. Dr. Furnas was director of Cornell Aeronautical Laboratory, Buffalo, from 1946 to 1955, when he was named chancellor. He was active in the former National Advisory Committee for Aeronautics and was a member of the Committee on Aircraft Construction. During World War II, Dr. Furnas served with the Office of Scientific Research and Development and also was director of research in Curtiss-Wright's Research Laboratory. He is the author of a number of books, including "America's Tomorrow; the Next Hundred Years."

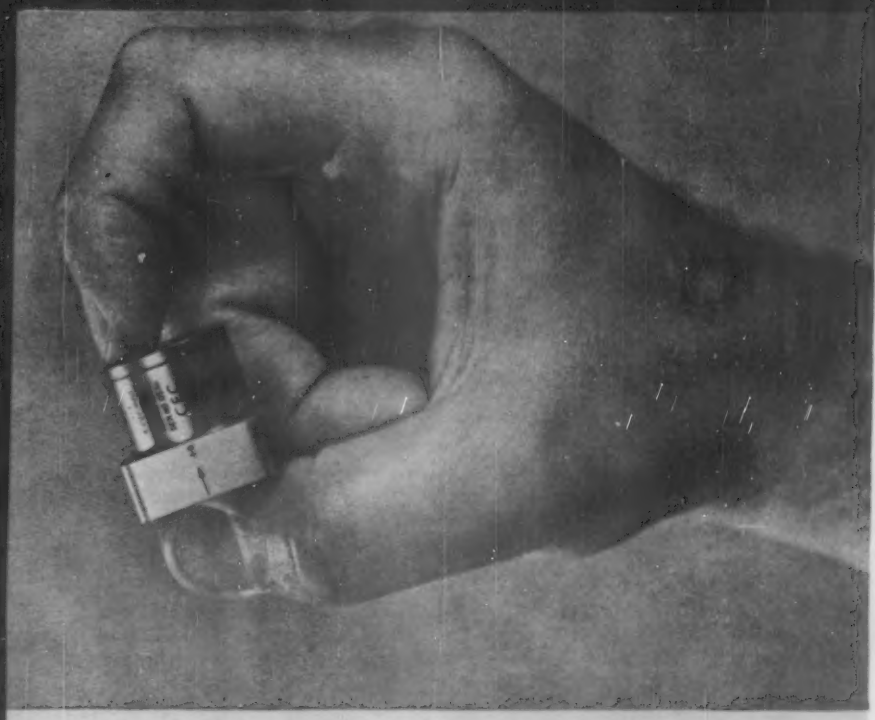
It is now a matter of history that Russia won this particular race, by launching the world's first successful man-made satellite on Oct. 4, 1957. Our complacency of that time was severely jolted; there was a wave of public chagrin and confusion but the overall effect was that American technology did receive a heavy shot of adrenalin. Despite many discouraging setbacks we now launch space objects with fair regularity and equip them with most ingenious instruments which divulge ever new and significant information about the environment which fringes the earth as well as that of the closer segments of the other parts of the solar system.

In the scientifically worthwhile aspects of satelliting, I judge that we are now well ahead of the Russians, even though we still take second place in the weight of single objects that can be put into a cruise path through space.

To a substantial degree we have counteracted our technological lassitude of five years ago. At the present time we, as a nation, are really very much bemused with as well as involved in the exploration and conquering of space. This embraces the most sophisticated and expensive experimental program that the nation has ever undertaken. National Aeronautics and Space Agency has a budget of about $1 billion a year —devoted largely to space activities. Undoubtedly the budget will grow. The military establishment now expends several billion dollars per year (including production and training) on long-range ballistic missiles (which are specialized spacecraft) and on various space-probing devices. These budgets will also grow.

These great expenditures of money and effort are justified to the public on three bases: first, military requirements; second, advancement of scientific knowledge of the universe; and third, the retention or attainment of international prestige. These objectives are not always consistent and are sometimes in conflict.

A certain school of thought among the military contends that just as there was a time when our nation could be safe only if it had control of the sea (later, control of the air became an added requirement) so now we must maintain complete control of space or



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all will be lost. However, there are others who believe that to be an overstatement of the case. There is no doubt about the military requirements for accurate, long-range ballistic missiles and for reconnaissance and communication satellites but does the military really need more than that? The argument flourishes at high levels but there are no really definitive answers. Whatever the ultimate plans, the program is going to be very expensive. Who is going to make the major and critical decisions about the program? The considerations will involve much more than technology.

Scientific Enthusiasm

The physicists and other scientists who are enthusiastic about space contend that no expenditure of money or effort is too great if it leads to a better understanding of our physical universe. The engineers, who, because of the intricate and complex gadgetry are intimately involved in all these programs, are readily infected with the same virus of enthusiasm.

On the other hand, some earth-bound scientists are viewing the trend with considerable alarm, perhaps tinged with fiscal jealousy. Biologists and medical researchers contend that an additional $100 million expenditure in their field (about the cost of one modest space exploration) might very well produce the breakthrough which could lead to the understanding of the cause and the discovery of cures for cancer. The investigators of high energy physics clamor for more and more apparatus. They are not thinking of mere peanuts. The proposed two-mile-long accelerator at Stanford will call for an initial investment of at least $125 million.

Some oceanographers are fomenting a scholarly revolt. They contend that the depths of the ocean are far more important than the depths of space and that our ignorance of the important facts about the Seven Seas is truly abysmal. A number of new oceanographic research vessels at a few million dollars apiece are called for, immediately. The geologists want to go under water, too. The "Mohole" project which will involve drilling into and sampling the inner-crust layer of the earth's skin, under about 30,000 ft. of water, is most intriguing. Undoubtedly the information obtained would be very important and it might be gotten for a bargain price of about $50 million.

While military necessity and the scientific urge are impelling motives, they are always backed up by an uneasiness about our international posture. Our defensive gloom seems to take the shape of a shadow that looks curiously like the Russian bear. Even so, there is a tendency among some researchers to pooh-pooh the importance of the pres-

tige factor. They say it is unbecoming of a scientist to have anything to do with, or give any consideration to, international propaganda. However, even they can hardly ignore glaring headlines which give evidence of decreasing confidence in America because Russia occasionally manages another technological coup. Our national standing is very much at stake and this is a most powerful motivating factor in our national program.

While the scientists and engineers jockey for position and government support in the glamor fields, the college and university professors stand on the side lines (along with their presidents) and wring their hands. "You are robbing us of our faculty" they cry. They are not entirely consistent because many of their institutions are heavily involved in extensive research on these stupendous projects. Yet there is no gainsaying the fact that the competition of fancy salaries, project glamor and, in some cases, patriotism, is denuding the faculty ranks in quality as well as numbers, just at a time when unprecedented demands are bearing down on institutions of higher learning.

It is quite evident that there is not now enough human talent (and probably not enough financial resources) to do all the wonderful things which America seems to be demanding of itself. Patterns and programs seem to evolve at random or are arrived at by default. It may be contended some great and firm decisions must be made but unless we are to be the subjects of an omniscient dictator, who is to make them? Such decisions in our complex world involve matters which are for the most part beyond the ken of legislators, government executives or the usual variety of businessmen.

National Decision-Making

Perhaps they are not aware of it, but the scientists and engineers are playing an increasingly important role in national decision-making. In their posts as employes of government agencies, in the military services, as members of advisory bodies, they frequently are in a prime position for making value judgments about these very expensive and important national programs. The creation of the positions of Special Assistant to the President for Science and Technology and the scientific attaches at the ambassadorial posts is further evidence of the impact which scientists and technologists have in passing judgment on non-technical matters. The criteria for making such judgments are not to be found in any textbook, nor are they clearly delineated in any available statements of national policy. The role of the scientist and engineer in our national well-being is far more complicated than it was in the

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Target Missile Sets Altitude Record

RP-76 rocket-powered missile recently established a new target missile altitude of 72,500 ft. at White Sands Missile Range, N. M. Manufactured by Radioplane Division, Northrop Corp., the missile attained a speed of Mach 1.03 during flight.

good old days of a generation ago.

Although these major national affairs loom large, they by no means encompass the whole pattern of our technological life. It might be revealing to review some other items of technology which involved aspects of judgment which are not considered in the traditional academic curriculum.

Bridge Design

One of the outstanding structures in our country is the George Washington Bridge which spans the Hudson from 172nd St. in New York City to the Jersey Shore. In the original design the two supporting end columns of this great suspension bridge were to be covered with masonry in keeping with tradition. This was justified on the economic grounds of protection of the steel structure from the weather. These masonry columns were the subject of a great deal of debate and finally, after considerable argument, the design was changed, eliminating the masonry and leaving the steel towers with their open, lacy structure exposed to the weather, even though the economics argued against such a change. The decision was made on the presumption that open towers would be much more beautiful than ones which were covered with a layer of somber stone. Here was a case where the decision was made on the basis of aesthetics, rather than the usual engineering criteria plus economics.

One of the most debatable and debated projects of the New Deal Days of the 1930's was the Tennessee Valley development involving power dams, flood control and the introduction of new industries. The arguments, pro and con, ranged from the save-humanity theme of the enthusiasts to the cries of "economic boondoggle" of the conservatives. The project did proceed, of course, with extensive federal support, but the decisions were not made on a strictly economic or engineering basis. Essentially they were made with an eye to the sociological values involved, even though some of the critics said it was entirely partisan politics.

Now, after some twenty-five years, the Tennessee Valley Authority has been accepted as a part of American life and there is no question that it has greatly benefited the economic and social well-being of that extensive region. It is not possible to set up a national balance sheet to determine whether or not it has been "profitable" in the purely business sense. Probably no such a determination can ever be made. The point is that sociological factors, other than technology and simple profit or loss, have in the past and probably will in the future enter more and more into the major decisions involving certain engineering projects.

The nationwide rural electrification program under the aegis of the Rural Electrification Administration, which began in the same New Deal Days, was subject to the same debate and criticism as the Tennessee Valley project. This program involved the federal support of a wide-spread rural network of electrical systems which individual power companies, either privately or

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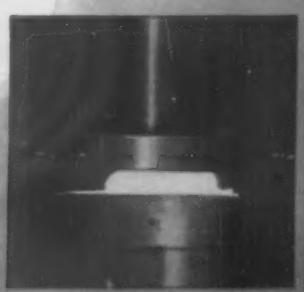

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municipally owned, could not justify on the basis of anticipated earnings. The debates on this subject were quite bitter with many accusations of political skulduggery and wastage of federal funds. Here again, however, the pattern of rural electrification is now quietly accepted and the various power companies which supply the energy are glad to have the business. It is true that the initial capital investment for the widely scattered customers could not have been justified to stockholders or to municipal governments.

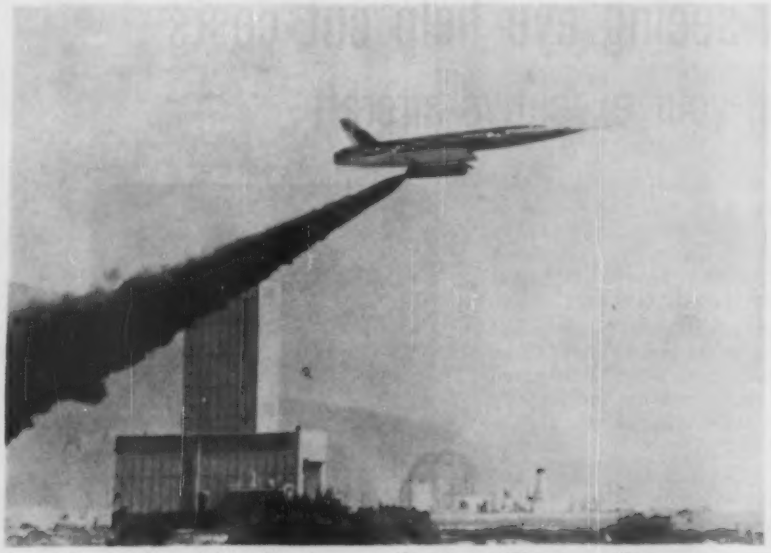
Economic Gains

There is but little debate, however, about the sociological as well as the economic gains that have resulted for the rural customers. Some 97% of rural America has now been electrified. More than 1,000 locally owned—mostly cooperatives—have paid some $1 billion in principal and interest on the $3¼ billion REA loans. That is not a very good return in 25 years from a strictly business point of view but when judged by the criteria of national economic and human welfare it may well be. Very few would want to go back to the old kerosene lamp or hand pump days, particularly if they happen to be rural residents. This, again, was a pattern of major decisions based on an over-all sociological rather than on a techno-economic basis.

We may turn now to a very different type of problem—one which looks to the future. The 1960 census reveals some very significant trends in American metropolitan centers. The core communities (downtown) are steadily losing residents and the suburbs beyond the city lines are growing, more or less explosively. This is due, of course, to the universal availability of automobiles. The dimensions of ancient cities were largely determined by the feasible walking distance. The early American city pattern developed around the horse-drawn vehicle, supplemented later by electric, public transportation. So the boundary lines of the city spread but the greatest concentration of residents tended to remain near the center. Now, however, the apparently innate desire of parents to give the kiddies breathing space and green grass, plus the propensity for independence exemplified by driving the private automobile has led to the exodus from the downtown areas.

But at the same time, whether it be from logic or habit, a large proportion of the business affairs remain concentrated in the central portion of the cities which the thousands have been abandoning as a place of residence. This leads to the twice-a-day cycle of utter congestion of driving to and from work with its attendant irritations, lost time and inefficiencies and struggles for parking space. Further, as the former residents migrate to the fringes they tend to be replaced at the core with economic and sociological undesirables; the old-time tax structure is fractured; the conglomeration of fragmented government organizations becomes obsolete. Does it really make sense? The question becomes more pertinent by the week.

Or, perhaps a community the size of New York City is too small a unit. The megalopolis which now extends from



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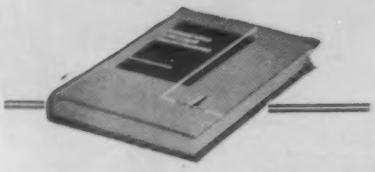

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Boston down the East Coast to Washington comprises an unprecedented sociological complex. In view of modern transportation and communication, should there be only a few concentrated nuclei of business and industry, or should the many activities be spread out in much smaller units? There have been many bits-and-pieces approaches to city planning but none, as far as I know, have been truly comprehensive in breadth and scope. Where are the engineers who will spearhead such studies? I feel confident that adequate talent is available if it were properly oriented. I am mentioning this rather Gargantuan task because when and if plans from such studies come to a point of decision economic, sociological and logistic factors will certainly loom as large as technology. However, the decisions which must be made will be essentially engineering in character, if one accepts the definition of engineering as the solution of problems of organized complexities.

In the years to come, a great many American engineers may well be pursuing their activities beyond our political boundaries. If our country is to maintain its leadership in Western civilization, a substantial proportion of our technologists will have to cease being homebodies and will become involved in the international scene. Our techno-sociological matrix inevitably spreads to other shores. I am speaking of more than the present foreign fragments of American business, military operations and foreign aid. One example will suffice to indicate the pattern.

Within the next half-century the world population will undoubtedly expand from the present two and three-quarter billion to five or six billion. From whence will come all the natural resources—particularly food, inanimate energy, minerals and water—to provide the physical wherewithal for a reasonably acceptable standard of living for these many billions of people? It is obvious that we, as a world, are going to have to learn to get more and more from less and less in order to meet the bona fide demands. This is going to call for a great deal more basic research knowledge than we have at present and large amounts of engineering ingenuity. The expenditures for the necessary investigations can hardly be justified by individual private industrial organizations for the simple reason that financial profits will be a long time in coming, if ever. Yet if the nations of Western civilization, particularly America, do not undertake such studies, the Communist countries undoubtedly will—and they will use this path of technological progress to capture the uncommitted nations of the world.

What research and engineering developments should our nation undertake to help solve the problems of the continuing supply of natural resources for itself and the rest of the world? Who should carry them out and how should they be financed? These questions represent points of critical decision. If they ever are faced, the engineer will certainly have to play a primary role. He will necessarily have a major part in decision-making and involvement at the points of application of feasible developments.

In citing these examples I have touched on matters which obviously in-

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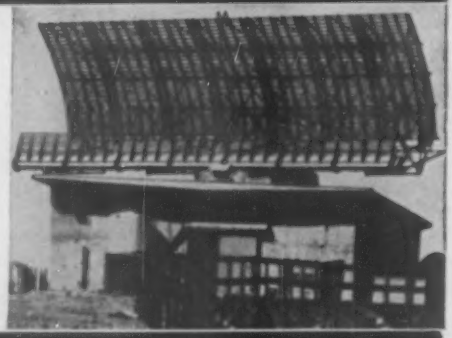
The Marconi S264A 50 cm. radar is the most advanced air traffic control radar in the world. It will operate anywhere, including mountainous country, in all weather conditions. It is designed for the control of jet aircraft from take-off to 150 miles plus, combining the three roles of Airfield Control, Terminal Area Control and Long Range Airways Surveillance. Several versions are now available to suit varied circumstances and continuous research is being devoted to ensure continued progress and development of Marconi 50 cm. radars.



cover the whole field

LONG RANGE SURVEILLANCE RADAR

This versatile radar can be adapted to a diversity of applications. The Moving Target Indicator eliminates the echoes from stationary objects. Distortion of the reflector profile is prevented by the main member being a 6' 8" diameter tube, thus giving increased accuracy over a longer life. A unique mechanical design feature ensures that the turning gear is unaffected by slight subsidence of the site. Like the S244 the equipment is 'all weather' and 'all climate' and will withstand wind speeds up to 120 knots without 'radoming'.

of ground radar

LONG RANGE HEIGHT FINDER

The Marconi S244 is the most advanced and accurate height finder in the world. In conjunction with the Marconi control system it can handle 15 random targets per minute. Height references are related to a shock mounted artificial horizon which overcomes the instabilities inherent in all large supporting structures and gives the greatest known accuracy. The equipment operates satisfactorily in all weathers and climates from Arctic snows to tropical monsoon precipitation. It may be 'radomed' for protection but will withstand wind speeds up to 120 knots without 'radoming'.

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volve public bodies: municipalities, states, the nation and even the world community. The trends of the immediate past and the prospects of the future all seem to give evidence of an increasing trend toward the welfare state. To one such as myself, who strongly believes in individuality and a free economy, this is a disturbing thought. But who has come up with any valid suggestions to counteract the trend? Those who contend that this is merely a matter of politics are evading the issue. The politics is an aftermath and not a cause. The sociological and the technological factors are the most important. I feel that imaginative engineers might have some really new approaches to contribute, and I hope they will.

Return now to the subtitle of this paper: "Who Really Makes the Decisions and Why?" The operation of human society will never be limited to the confines of neat scientific formulae, but it should be apparent by now that I believe the engineer, working in close liaison with the pure scientist, must play an increasingly important, perhaps a dominant, role in making the decisions and determining the management pattern of our future national program. This must be because science and engineering now dominate nearly all aspects of our physical existence and important decisions must be based on adequate knowledge and understanding of both the physical world and the human race. The necessary background for such a responsibility will involve much more than a compilation of data, familiarity with handbooks, facility with the slide rule or expertness with computers. Do our colleges and universities now provide an adequate educational background for the enlarging responsibilities? That is a most important question to which, unfortunately, at the moment we do not have the answer. It should furnish food for very serious and continuing pedagogical thought.

This analysis leads one to believe that there is real substance to the argument that in their student days engineers should effectively absorb a substantial dose of that type of liberal education which develops a concept of what people really are and what makes them tick. Further, it leads to the conclusion that intensive education about people and their affairs is a continuing requirement for the engineer. He must always have more than a mere speaking acquaintance with the arts, with sociology and political science as well as economics. His working library should include many non-technical books. His day-to-day reading should also embrace the better weekly news magazines, and such perennials as the New York Times, the Wall Street Journal and even the Congressional Record. ◆◆

NEW AVIATION PRODUCTS

Jet Transport Towbar Is Positioned by One Man

Towbar is fitted to the nosewheel axle of a Douglas DC-8 jet transport by a ramp serviceman. The Y-shaped 16-ft. towbar incorporates a handwheel to adjust the axle engagement pins. A crank adjusts the height of the tow-eye and raises the positioning wheels after hookup. Compatible with Douglas DC-6 and DC-7 aircraft, the towbar is produced for United Air Lines by the Industrial Service Co., Oakland, Calif.

Portable Water Separator

Portable filter/separator for removing water and solid contaminants from aviation and jet fuel is intended for use at unimproved Army airstrips.

The separator would be used in conjunction with hand pumps for fueling aircraft from 55-gal. drums. The 50 lb. filter/separator has a capacity of 20 gpm.; length is 30 in., diameter 8 in.

Warner Lewis Division, Fram Corp., Tulsa, Okla.

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Portable ground support air conditioner for full-pressure flight suits permits more comfort for pilots during

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SECRETARY OF THE AIR FORCE

Among those providing their leadership to this new non-profit public service corporation are: Dr. Ivan A. Getting, president; Allen F. Donovan, senior vice president, technical; Jack H. Irving, vice president and general manager, systems research and planning; Edward J. Barlow, vice president and general manager, engineering division; and Dr. Chalmers W. Sherwin, vice president and general manager, laboratories division.

These scientist/administrators are now selecting the scientists and engineers who will achieve the mission of Aerospace Corporation: concentrating the full resources of modern science and technology on rapidly achieving those advances in missile/space systems indispensable to the national security.

The functions of Aerospace Corporation include responsibility for: advanced systems analysis; research and experimentation; initial systems engineering; and general technical supervision of new systems through their critical phases, on behalf of the United States Air Force.

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Mr. James M. Benning, Room 101
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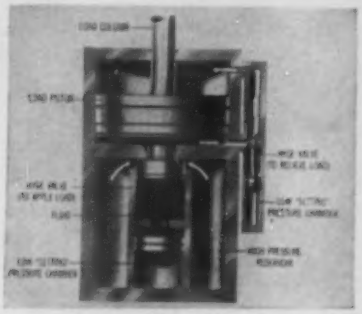
briefing and while on alert status.

The suit ventilator produces a 7 cfm. flow of air at a pressure of 2 psig. by means of a two-stage centrifugal blower powered by a silver cadmium 13 v. battery. Ordinary ice cubes act as a heat sink on the unit which cools the suit some 35F below ambient. The 18-lb. ventilator will cool pressure suit for periods up to 1 hr.

A. J. Sawyer Co., Inc., 597 Oakwood Ave., E. Aurora, N. Y.

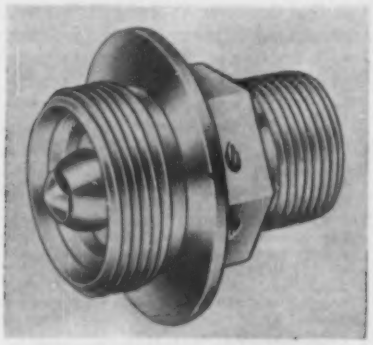


Dynamic Load Tester

Dynamic loads exerted during acceleration and deceleration of rocket engine firings are duplicated with a hydraulic test instrument. A primary application of the unit is in the design and testing of rocket motor mounts.

The Dynapak load tester, employing two Hyge valves, can apply 1.5 million lb. of force in 0.0001 sec.; decay time is 20 milliseconds. Load level, rise time, dwell time and decay time may be controlled externally. The units may be applied in parallel for higher forces.

Convair Dynapak, 435 W. Fifth, Pomona, Calif.



High Temperature Chip Detector

Magnetic chip detector is satisfactory at 600F permitting more applications in high temperature areas.

The magnetic chip detector, which detects metal particles in gear cases, constant speed drives and oil sumps, indicates the presence of metal in that the particles bridge a circuit. The elimination of elastic seals on the new model permits the higher temperature applications.

Lisle Corp., Clarinda, Iowa.

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FINANCIAL

New Offerings

All American Engineering Co., Wilmington, Del., primarily engaged, under government sponsored contracts, in research, development and manufacturing activities relating to the aircraft, satellite and missile fields. Offering is 85,918 shares of common stock for subscription by holders of outstanding stock on the basis of one new share for each four shares held; subscription price and underwriting terms to be supplied by amendment. Proceeds will be used for general corporate purposes, including reimbursement and payment for capital expenditures of about $300,000 for 1960, a portion of which will be used for the construction of a laboratory and manufacturing building adjacent to the company's general offices in Wilmington. The company contemplates the expenditure during the following two years of about $700,000, including $150,000 for laboratory and testing equipment and $550,000 for machine tools and other capital items.

Aircraft Armaments, Inc., Cockeysville, Md., engaged in applied research and development in the fields of aerodynamics, ballistics, electronics, ordnance, and electro-mechanics and in the design and manufacture of electronic, electrical, and mechanical devices largely for the Department of Defense. Offering is 275,000 outstanding shares of common stock. These shares are to be offered by United Industrial Corp., a Delaware corporation, to its stockholders of record on Nov. 18, 1960, for subscription at the rate of one share of Aircraft Armaments stock for each eight shares of United Industrial common stock held; subscription price and underwriting terms to be supplied by amendment. Purpose of the offering is to provide United Industrial with additional funds for general corporate purposes and, together with the distribution of 53,100 shares of the company's common stock to common stockholders of United Industrial on Sept. 16, 1960, to "broaden the market" for the company's stock. United Industrial has no present intention of disposing of any of the other 343,900 shares of Aircraft Armaments' stock owned by it.

Stock Transactions

The Securities and Exchange Commission's Summary of Security Transactions and Resultant Holdings for the period July 11 to Aug. 10, 1960, reported the following transactions by three executives of Marquardt Corp.: acquisition of 100 capital shares by William Littlewood, director, making a holding of 100; disposition of 200 capital shares by William H. Schwebel, officer and director, leaving a holding of 630; disposition of 200 capital shares by Harper Woodward, director, leaving a holding of 3,400.

Other transactions for the period July 11 to Aug. 10 include:

Allegheny Airlines, Inc. Disposition of 1,000 common shares by Hamilton O. Hale, director, leaving a holding of 1,500.

Atlantic Research Corp. Disposition of 200 common shares by Keith E. Rumbel, officer, leaving a holding of 19,100; disposition of 1,000 common shares by Franklin C. Salisbury, officer and director, leaving a holding of 4,950; disposition of 250 common shares by P. S. Shane, officer, leaving a holding of 16,350.

Avco Corp. Disposition of 3,300 common shares by James R. Kerr, officer and director, leaving a holding of 6,000; disposition of 300 common shares by W. A. Mogenson, director, leaving a holding of 9,000; disposition of 4,000 common shares by K. R. Wilson, Jr., officer and director, leaving a holding of 11,000.

Beloek Instrument Corp. Disposition of 2,050 common shares (private transaction) by Harry D. Beloek, officer and director, leaving a holding of 223,496.

Braniff Airways, Inc. Acquisition of 5,000 common shares by William A. Blakley, director, making a holding of 522,955; disposition of 1,000 common shares, his total holding, by Allan Shivers, director.

Cessna Aircraft Co. Acquisition of 5,000 common shares by Frank A. Boettger, direc-

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SMALL SIZE: Eastern gear pumps are the smallest, lightest made. An airborne servo system pump delivers 1.5 gpm @ 1500 psig — measures only 1⅞" x 1⅞" x 2¾", weighs 9 oz.

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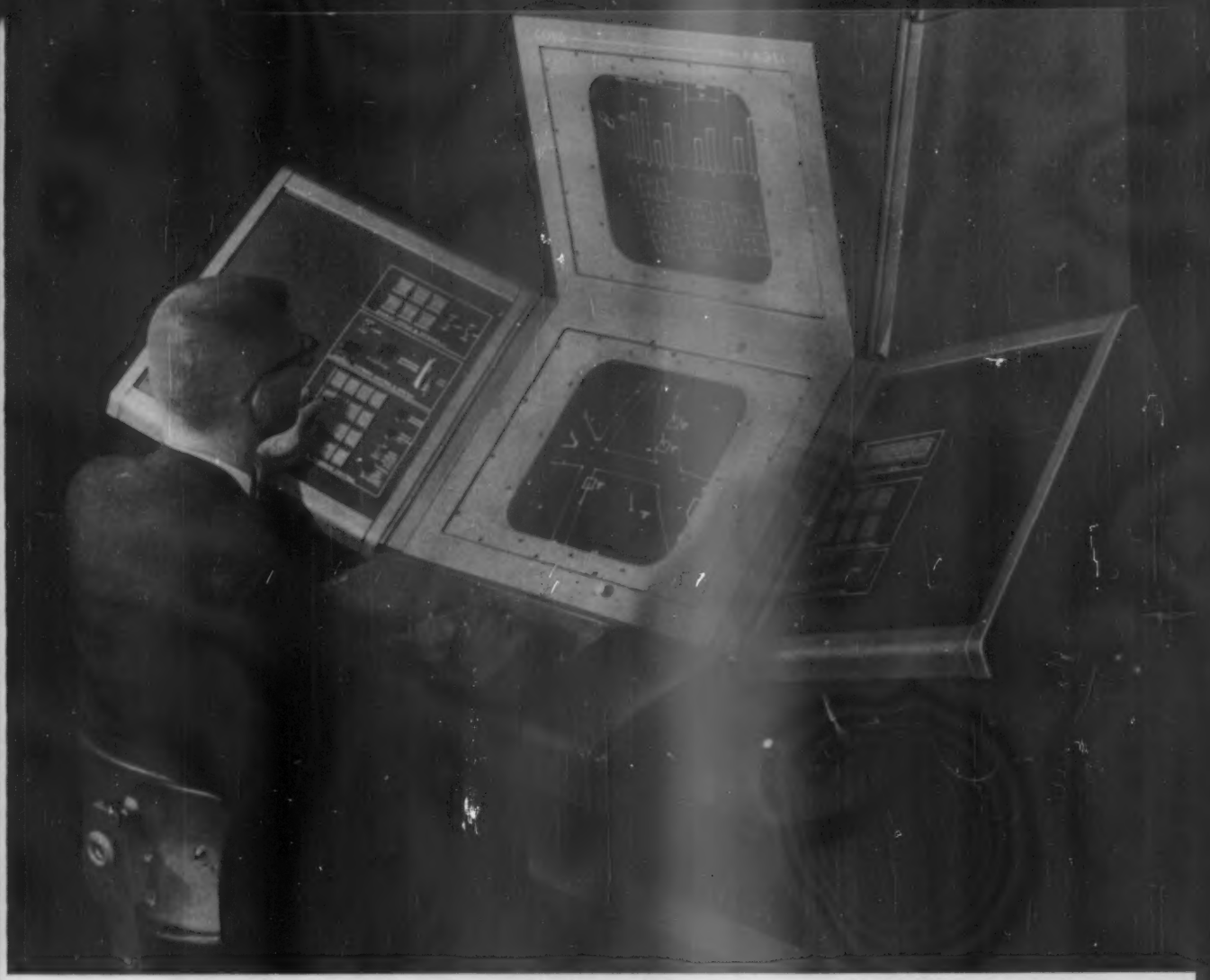

PERFORMANCE ON TRIAL Bendix achieves optimal man/machine interfaces in early system design through testing on its Computer Operated Electronic Display (COED). Designed to simulate the operator's station in the EAGLE Missile System, COED also permits real-time evaluation of energy management systems, logistic control, teaching methods, process analysis, and command control. Career positions are open involving use of this advanced technique for system design.

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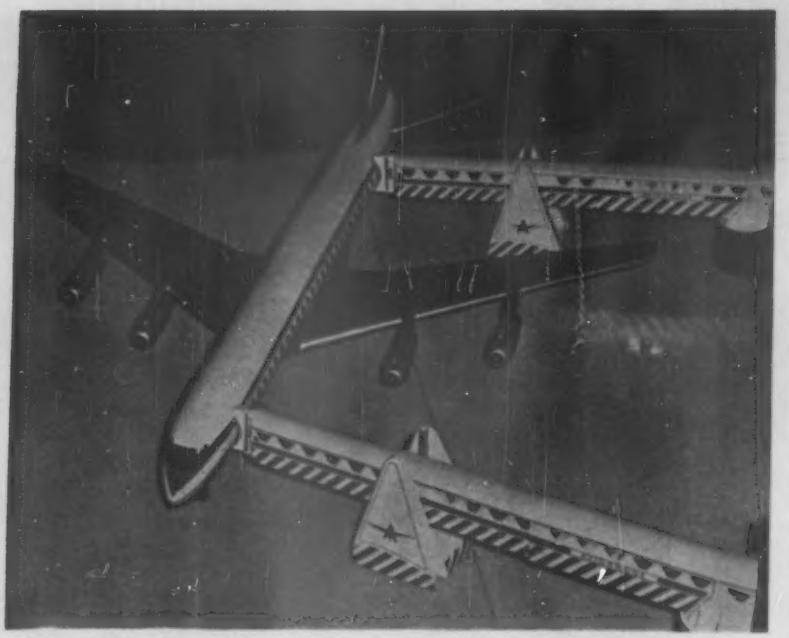


Dutch Develop Electrically Controlled Ramp

Enclosed passenger ramp above has three-section telescopic arm extending 120 ft. from departure gate to cabin door. Arm revolves electrically from stationary platform. Angle of incline of the ramp is variable to permit height adjustments between cabin door and exit gate. Hydraulic servo-system controls fluctuations, during passenger loading; other controls prevent jarring by wind gusts up to 62 mph. Netherlands Trade Commission is agent for Maatschappij voor Vliegtuigbouw, N. V., the Dutch manufacturer of the ramp.

tor, making a holding of 22,325 shares.

Chance Vought Aircraft. Disposition of 200 common shares by James J. Gaffney, officer, leaving a holding of 100.

Collins Radio Co. Disposition of 500 common shares by Max W. Burrell, officer and director, leaving a holding of 2,630.

Curtiss-Wright Corp. Acquisition of 1,200 common shares by T. Roland Berner, director, making a holding of 2,400.

Douglas Aircraft Co. Disposition of 900 capital shares by Edward H. Heinemann, officer, leaving a holding of 1,120; acquisition of 200 capital shares by George W. Romney, director, making a holding of 200.

Eastern Air Lines, Inc. Disposition of 500 common shares by Thomas E. Creighton, officer and director, leaving a holding of 4,870; disposition of 200 common shares by Robert S. Lipp, officer, leaving a holding of 295.

Fairchild Engine & Airplane Corp. Acquisition of 100 common shares by Floyd S. Bennett, Jr., officer, making a holding of 100.

General Dynamics Corp. Disposition of 10,000 common shares, his total holding, by Rex L. Nicholson, officer.

General Electric Co. Disposition of 1,000 common shares by John W. Belanger, officer, leaving a holding of 18,068; disposition of 5,500 common shares by James H. Goss, officer, leaving a holding of 3,942; acquisition of 3,960 common shares through exercise of option by Francis K. McCune, officer, making a holding of 13,289; acquisition of 174 common shares by Halbert B. Miller, officer, making a holding of 3,138; disposition of 746 common shares, his total holding, by J. B. Montgomery, officer; disposition of 2,000 common shares by Harold A. Olson, officer, leaving a holding of 4,327; disposition of 2,000 common shares by Robert Paxton, officer, leaving a holding of 23,727; acquisition of 2,645 common shares by Charles E. Reed, officer, making a holding of 3,529.

General Precision Equipment. Disposition of 900 common shares by Joel Dean, director, leaving a holding of 500; acquisition of 500 common shares by The Martin Co., beneficial owner, making a holding of 192,900; disposition of 100 $4.75 preferred shares, his total holding held indirectly in partnership, by J. C. Maxwell, director.

Hiller Aircraft Corp. Acquisition of 630 capital shares, in payment of note dated Oct. 31, 1952, by Francis A. Callery, director, making a holding of 1,680; disposition of 3,817 capital shares, in payment of note dated Oct. 31, 1952, by Stanley Hiller, Jr., officer and director, leaving a holding of 101,183; acquisition of 1,050 capital shares by Henry L. McIntyre, director, making a holding of 1,050; acquisition of 877 capital shares, in payment of note dated Oct. 31, 1952, by A. W. B. Vincent, officer and director, making a holding of 14,845.

Loral Electronics Corp. Disposition of 200 common shares by Bernard R. Garrett, officer, leaving a holding of 325; disposition of 245 common shares by Sidney Rydell, director, leaving a holding of 4,680.

North American Aviation. Disposition of 300 capital shares by S. K. Hoffman, officer, leaving a holding of 100; acquisition of 2,000 capital shares by J. Stanley Smithson, officer and director, making a holding of 2,516; acquisition of 500 capital shares through exercise of option by W. H. Yahn, officer, making a holding of 800.

Raytheon Co. Disposition of 6,000 common shares by Percy L. Spencer, officer and director, leaving a holding of 2,188.

Resistoflex Corp. Disposition of 600 common shares by Raymond H. Liebold, officer, leaving a holding of 43.

Seaboard & Western Airlines, Inc. Disposition of 21,958 common shares by Carl D. Brell, officer, leaving a holding of 8,145; disposition of 2,095 common shares by Harold Montee, officer, leaving a holding of 10,807; disposition of 4,737 common shares held indirectly in joint tenancy by Wallace P. Neth, officer and director, leaving a holding of 14,660 (direct holding remains 116); disposition of 1,000 common shares by Arthur V. Norden, officer, leaving a holding of 11,127; disposition of 12,000 common shares by Raymond A. Norden, officer, leaving a holding of 126; disposition of 4,500 common shares by Warren H. Renninger, officer, leaving a holding of 4,308; disposition of 10,000 common shares by Charles B. Ripley, director, leaving a holding of 15,962; disposition of 13,000 common shares by John H. Rosenwald, officer, leaving a holding of 37,379; disposition of 19,000 common shares by F. H. Vahlsing, director, leaving a holding of 38,600.

Standard Kollsman Industries, Inc. Disposition of 1,030 common shares, his total holding, by Walter F. Hermann, officer.

Thiokol Chemical Corp. Disposition of 1,000 common shares by Alfred Rawa, Jr., officer, leaving a holding of 9,443.

Thompson Ramo Wooldridge, Inc. Disposition of 100 common shares by Harold L. George, director, leaving a holding of 36,135; disposition of 500 common shares by Burton F. Miller, officer, leaving a holding of 3,157, and disposition of 700 common shares held indirectly in trust, leaving a holding of 8,600; disposition of 550 common shares by Edward P. Riley, officer, leaving a holding of 1,530.

United Air Lines, Inc. Disposition of 200 common shares by Curtis Barkes, officer and director, leaving a holding of 4,949; acquisition of 122 common shares through exercise of option by L. F. Hampel, officer, making a holding of 150; acquisition of 745 common shares by John M. Hodgson, officer, making a holding of 1,443; acquisition of 300 common shares through exercise of option by Daniel V. O'Leary, officer, making a holding of 775.

United Electric Coal Companies. Acquisition of 12,100 common shares by General Dynamics Corp., beneficial owner, making a holding of 250,103.

FAA Contracts

Washington—Following is a list of unclassified contracts for $25,000 and over as released by Materiel Contracts Branch, Federal Aviation Agency:

Lenkurt Electric Co., Inc., San Carlos, Calif., contract FA-1055(1-1008) system, telephone carrier, Lenkurt Electric Co., Inc's. Type 45BX3, one system, instruction book, same as and in addition to instruction books furnished with item 1, 2 ea., spare parts, set, for use with item 1, one set, kit accessory for item 1, two kits, $40,354.

Dietz Design, Inc., Grandview, Mo., contrast FA-1071(1-1018) receiver changeover and hybrid panel, 800 ea., spare parts, set, for use with item 1, 80 sets, prepare and furnish replaceable parts list for item 1, one list, item identification for replaceable parts in item 1, estimate 25 ea., estimated cost $143,805.

Sigma Electronics Research Corp., Seattle, Wash., contract FA-1072 (1-1044) loops, antenna, 108-112 mc., 600 ea., spare parts, set, for item 1, 5 sets, antenna phasing and changeover unit, 21 ea., spare parts, set, for item 3, 5 sets, prepare and furnish replaceable parts list for items 1 and 3, one list, item identifications for replaceable parts in items 1 and 3, estimated 100 ea., estimated cost, $172,800.

Superior Cable Corp., Hickory, N. C., contract FA-1066 (1-3020), cable telephone, 26 pair, #19, type 1, in accordance with specification CAA-1046a, 36.0 M ft., cable telephone, 101 pair, #19, Type 1, in accordance with specification CAA-1046a, 56.0 M ft., $58,211.

Finetoid Corp., Hamburg, N. J., contract FA-1068(1-3020) cable, control, 12 shielded pair, #19, 600-volt non-armoured, type 1A, in accordance with specification CAA-893b, 200.0 M ft., cost of each returnable reel, 100 ea., $88,500.

Collyer Insulated Wire Co., W. A. Leiser & Co., Sales Representative, Philadelphia, Pa., contract FA-1067(1-3020) cable, control, 12/c/12, 600-volt, non-armoured, type 2A(special), in accordance with specification CAA-893b, 54.0 M ft., cost of each returnable reel, 27 ea., $27,705.

Duplex Division, Warner & Swasey Co., Lansing, Mich., contract FA-1078(1-3033),

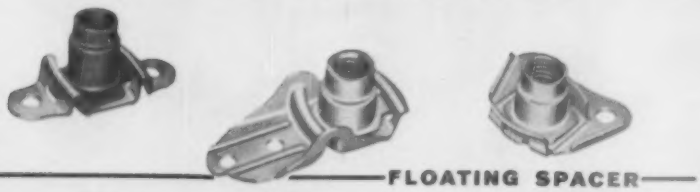
Just name your lightweight locknut requirement...

SPS offers a Nutt-Shel type for almost every application need

FIXED ANCHOR

FLOATING ANCHOR

HEX — FLOATING CLINCH



FLOATING SPACER

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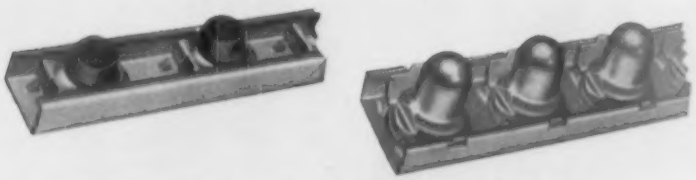

GANG CHANNEL

Fixed anchor, floating anchor, spacer . . . whatever your requirement in this class of locknut, SPS provides a Nutt-Shel design to meet it.

Nutt-Shel lightweight locknuts are part of SPS's complete line of aircraft/missile fasteners, which includes all AN, MS and NAS types—bolts and locknuts—plus SPS special high-performance types. Among the latter you can specify bolt/locknut combinations for temperatures to 1600°F., tensiles to 260,000 psi and shear strengths to 156,000 psi. And looking to tomorrow, the SPS laboratories for advanced research are already testing prototypes of fasteners offering even higher levels of performance and mechanical reliability.

For more information, write Standard Pressed Steel Co.—manufacturer of precision threaded fasteners and allied products in many metals, including titanium. Bulletin on Nutt-Shel products is available on request.

Specifications—Nutt-Shel Lightweight Locknuts

Materials
Alloy Steel Nuts: Threaded element per AMS 6350; Corrosion-Resisting Steel Nuts: Threaded element per AMS 5525 (A-286).

Performance
Meet or exceed AN-N-10 and/or MIL-N-25027 (ASG). Alloy steel nuts serviceable to 550°F., corrosion-resisting nuts to 900°F.

Mounting Styles
Standard rivet holes, dimpled rivet holes for flush mounting, or projection weld dimples.

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Variety of platings and lubricants available.

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engine generator, automatic, gasoline, 18.75 KVA, one phase, 60-cycle, 120/240 V, three-wire, in accordance with specification FAA-547g and supplement no. 72 thereto, 125 ea., replaceable parts list for item 1 in accordance with specification FAA-G-1210a, one list, item identification for replaceable parts of item 1, estimated 200 ea., $396,-620.

Stewart and Stevenson Services, Inc., Houston, Tex., contract FA-1079(1-3033) engine generator, automatic, gasoline, 25 KVA, one phase, 60-cycle, 120/240 volt, three-wire, in accordance with specification FAA-574g and supplement no. 73 thereto, 15 ea., prepare and furnish replaceable parts list for engine generator, one list, item identification for replaceable parts of engine generator, estimated 350 ea., $89,790.

Minnesota Mining and Manufacturing Co., St. Paul, Minn., contract FA-1082(1-3159) 1½ in. tape, magnetic recording, wound on 10½ in. reels, with tape clip, 4,224 ea., $253,059.

Ferry & Wallis, Inc., Washington, D. C., contract FA-NA-55 (3130), furnish all necessary labor, tools, equipment, plants, supplies, and transportation (including fuel, power and water) and perform all work to demolish and/ or dismantle the South Concourse of the Main Terminal Building, rehabilitate the South Finger Building and vestibules #1 and #2 of the Main Terminal Building and to construct a new concourse, Washington National Airport, $163,914.

Avon Electrical Supplies, Inc., Jamaica, N. Y., contract FA-1019(1-3005) cable, power, 4/c(3/c #6 and 1/c #8 bare), 5,000 volt, type 1B(armored), 1,000 ft. per reel, 32 MFT, 1,000 ft. returnable reel, 32 ea., $42,560.

Circle Wire & Cable Corp., Maspeth, N. Y., contract FA-1020(1-3005) cable, power, 2/c #10, 600 volt, type 2A(non-armored), 2,000 ft. per reel, in accordance with specification of contract, 30 MFT, 2,000 ft. returnable reel, 15 ea., 2/c #8, 5,000 volt, type 1B(armored), 2,000 ft. per reel, 80 MFT, 2,000 ft. returnable reel, 40 ea., $54,515.

Crescent Insulated Wire & Cable Co., Trenton, N. J., contract FA-1021(1-3005) cable, power, 1/c #4, 600 volt, type 2A, 1/c #8, 5,000 volt (non-armored), in accordance with specification of contract, 1,690 MFT, returnable reels, 845 ea., $230,780.

General Cable Corp., Washington, D. C., contract FA-1022 (1-3005), cable, power, 2/c #6, 3/c #8, 5,000 volt, Type 1B(armored), 2,000 and 1,000 ft. returnable reels, 239 ea., $416,669.

Wickes Engineering and Construction Co., Camden, N. J., contract FA-1060 (1-3017) clock, digital, 24-hr., 60-cycle, 110-125 volt, with case, type A desk model, in accordance with specification CAA-1127a, 300 ea., clock, digital, 24-hr., 60-cycle, 110-125 volt, without case, Type B, for use with or without master control clock, in accordance with above specification, 800 ea., prepare item identifications for replaceable parts of items one and three, estimated 40 ea., $121,750.

AMC Contracts

Wright-Patterson AFB, Ohio—Following is a list of unclassified contracts for $25,000 and over as released by the Air Materiel Command:

The Arc Equipment Corp., Bryan, Ohio, converters, liquid oxygen type GCU-17/A, contractor's P/N 21086-1, Aerno 46-0106 (for the B-52G and H aircraft), contract AF 33-(600)42137, 48 ea., $48,272.

Bell & Howell Co., Chicago, Ill., plates, aperture, contractor's drawing No. 063195, FSN 6730-341-7842, 650 ea.; shuttles, contractor's drawing No. 061193, FSN 6730-356-6982, 1,385 ea., for 16 mm. motion picture sound projector AQ-2 and AQ-3, supplemental agreement No. 3 to contract AF 33-(600)40940, $25,378.

Hudgins, Thompson, Ball and Associates, Oklahoma City, Okla., architectural engineering (Title 1) services for a standard fuel systems maintenance dock, contract AF 33-(600)42087, $46,890.

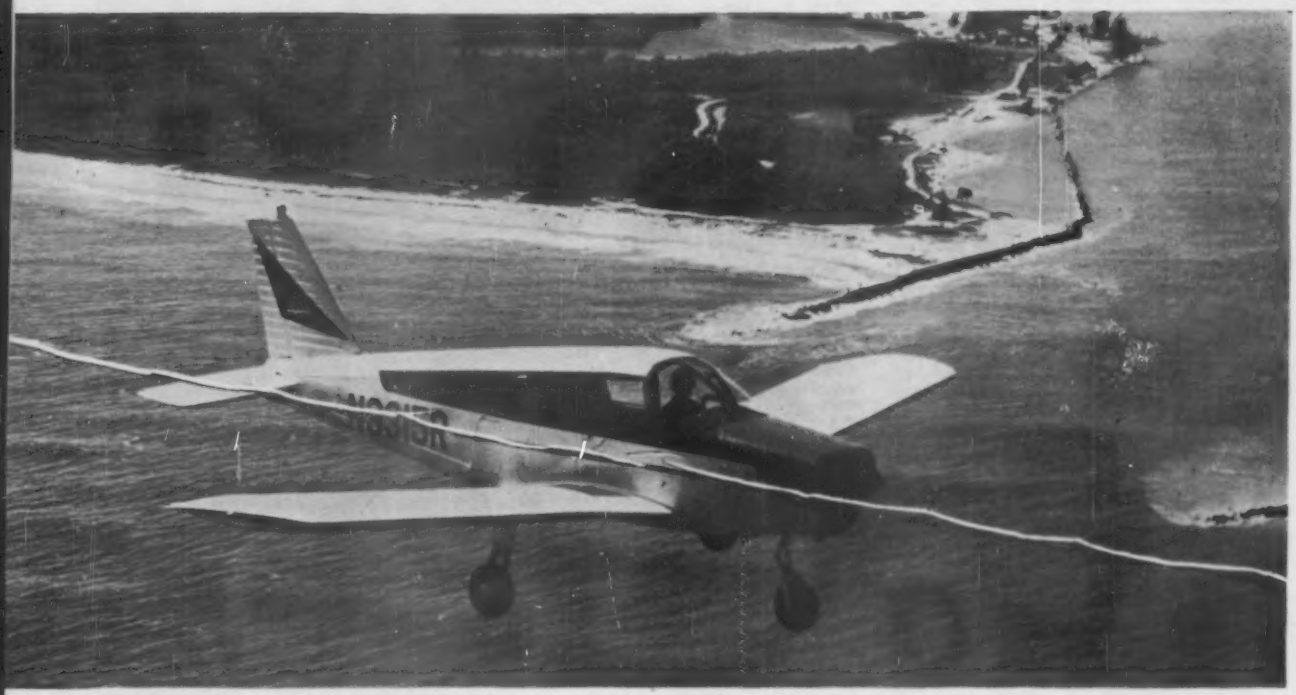
The Arc Equipment Corp., Bryan, Ohio, converter, liquid oxygen type GCU-2/A, Aerno 46-0100, USAF installations for F-105, T-38A aircraft and data, contract AF 33-(600)42032 (IFB 33-600-61-2), $321,977.

Magnetic Instrument Co., Inc., Thornwood, N. Y., indicator, liquid oxygen quantity, type GMU-11/A, Aerno 46-1001, USAF installations for F-105 aircraft, and data, contract AF 33-(600)42019, 233 ea., $87,645.

Flight Propulsion Division, General Electric Co., Cincinnati, Ohio, J79-GE-11A turbojet engines with afterburner, in accordance with contractor's specification E-716E dated June 21, 1960, contract AF 33(600)42021, 48 ea., $2,862,000.

Lockheed P2Vs Get ASW Avionics Gear

Anti-submarine warfare avionics gear is being installed on the Lockheed P2V Neptunes at Lockheed's Burbank, Calif., facility. Plane is now in its seventh model and production is scheduled through April, 1962. It has been sold to seven foreign countries.



PIPER CHEROKEE is replacement for the Tri-Pacer and will enter production at Vero Beach, Fla., early in 1961.

Piper Widens Lower-Priced Airplane Line

By Herbert J. Coleman

Grand Bahama Island—Piper Aircraft Corp. has designed two new airplanes to capture a greater share of the low-cost airplane market while still pursuing wider sales of its "tribal" line—the Comanche, Aztec and Apache.

The new airplanes are the forerunners of an increasing emphasis on research and development at Piper which, executives promised, will result in a new model every year. The planes are:

- **Colt** two-place sport and business plane which will sell for $4,995 and is largely derived from the high-wing four-place Tri-Pacer (AW Oct. 31, p. 34).
- **Cherokee**, a four-place low-wing aircraft designed to replace the Tri-Pacer and which will sell for $9,995. It received Federal Aviation Agency approval during Piper's international distributor meeting at the Grand Bahama Club.

The Cherokee, like the Piper Pawnee agricultural plane, was developed at Piper's new Vero Beach, Fla., production facility, where it will be built early next year on a five-a-day basis to start. The Colt will be manufactured at Piper's main plant at Lock Haven, Pa., and, according to William T. Piper, president, "it will be the last of the high wings," referring to future development.

The announcement to about 300 persons attending the sessions, some coming from as far away as New Zealand, capped a report by J. W. Miller, general sales manager, that Piper is aiming at a record year in 1961 with sales aiming at a $62,500,000 retail total.

Overseas Sales

Part of this will come from increased sales efforts overseas, according to Wally Sawchuck, export sales manager. In 1961, exports have accounted for $6 million worth of business, he said, and Piper hopes to appreciably expand that figure next year.

Sales this year, Miller pointed out, will reach about $51,500,000 "and it looks like the best year ever, despite a recession this summer." Sales in 1959 were $44 million.

Total unit sales in 1960 are 2,593 airplanes, Miller said. He claimed that Piper captured 35% of the twin-engine market with its Aztec and Apache;

Small Airport Expansion

Grand Bahama Island—General aviation must look for future expansion to the small cities and the airports they can provide, William T. Piper, president of Piper Aircraft Corp., said here.

He predicted that the day of the small, non-operated airport will be a necessity to ensure the wide use of the lightplane. With more fuel tankage available, the lightplane no longer needs the airport merely as a fuel stop, but can use it for both business and pleasure in a wider area of flight.

Piper pointed out that "as airlines get bigger and the airplanes become faster, the stops get fewer and existing airports get more complex." Small city airports need not be expensive; grass strips will suffice, he said, and seven acres are sufficient for development. He also pushed for community ownership, instead of private ownership.

Piper keynoted the 21st Annual International Distributor Meeting at the Grand Bahama Club, contending it is the first of its kind held on foreign soil. Overseas distributors attending were Charles Brazier, New Zealand; F. G. Marginson, Australia; T. A. Vigors, England; the Marquis of Kildare, Ireland; E. A. Goemans, France; Peter Van der Woude, South Africa, and John Kent, Switzerland. Next year's meeting probably will be held at the new Vero Beach, Fla., production plant.

30% of the high performance single-engine market with the Comanche 180 and 250; 74% of the special purpose market with the Super Cub and Pawnee agricultural airplane and 22% of the training, utility and sports plane market with the Tri-Pacer and the Caribbean.

To push sales toward the anticipated 1962 figure, Piper dealers will sell the Colt on an installment credit basis—$995 down and payments of $29.68 a week. Contracts will be made through Commercial Credit of Maryland, Inc., and Piper expects the entry into this phase of credit-purchasing to markedly stimulate Colt volume.

Basically, Piper is looking for the Colt to restimulate a sport and student flying interest that has waned in the 1950s. The Colt's low price, plus a drive to sell the plane to flying clubs on a "Learn to Fly the Colt Way" campaign, is expected to accomplish this.

Business Application

Piper also will push the Colt as a business plane for operators of small firms who need the plane for comparatively compressed markets—say 100 mi. radii from their operations.

As Wally Smith, assistant general manager of sales, put it:

"The Colt will be within the financial reach of more students than any plane being built today. We want to sell the Colt to every airport operator that can use it, stressing its sport and instructional capabilities."

In the meantime, the Cherokee will move into a field established by the Tri-Pacer, whose sales pattern has been declining from 1,149 planes sold in 1956, to 594 so far this year.

"The Colt will be the wide-base-market airplane," Miller noted. "Then we'll narrow the base with the Cherokee and the Comanche, giving us three single-engine planes to work with."

Eventually, Miller said, Piper hopes to develop a stable of 750 Colt dealers and will do away with the so-called A, B & C class dealerships, attaching the plane name to the corporate name. He said the company hopes to be able to increase combined dealerships (single and twin engines) to 494 from the present 300.

"We must reorganize and expand the dealer group in order to grow," Miller stressed. "We can make aviation history with the new planes in terms of basic costs, lower purchases and rentals."

Need for dealer organization is evident from past history, Miller continued. In 1950, Piper had 2,000 dealers and they sold only 1,100 airplanes for a $4 million retail gross. By pruning this mass—taking into consideration key locations, finances and management, merchandising ability, etc. Piper finally settled on 365 dealers.

Piper also is branching into the avionics field and has established an Electronics Division at Vero Beach which c..rently is building its new low-frequency Autonav receiver and homing device on a four-a-day schedule.

Temporary Housing

The division is housed in temporary quarters and unit production will be increased when new quarters are completed. The Autonav sells for $395, weighs 4 lb. 11 oz. and is aimed at the Colt and Cherokee class of airplane. Piper's Autoflite automatic pilot is built at Lock Haven and has been an important sales factor, according to Howard "Pug" Piper, vice president in charge of research and development. It costs $1,995 installed (breakdown is $750 for the aileron control, $750 for pitch control and the balance for altitude control).

Piper now is developing a true airspeed indicator and may move into the VHF field in the future although Howard Piper observed that "we are not competing with Collins and Narco in the higher priced field."

The Vero Beach operation, where the Cherokee will be built, was obtained by Piper from the City of Vero Beach on a 99-year lease; the company now is negotiating for an additional 85

TWO-PLACE Colt 108 is Piper's entry in the sport and student flying field. Plane sells for $4,995 in standard model.

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CHEROKEE lightplane has Piper's swept-back tail, resembles high-performance Comanche.

THICKNESS of wing can be seen in this view. Piper has not yet revealed exact specifications.

acres to add to the present 20-acre site. Main building is expandable to the south; walls are supported by three columns and can be moved southward to extend roof and floor areas. Plant is headed by Luther Blume, former director of purchasing at Lock Haven.

Cherokee will be built in a 120,000 sq. ft. factory area still in the process of completion; first two prototypes, however, were built there, although new tooling and jigs are still being installed. Planes will follow a U-pattern ending at the paint shop which will include hydraulic hoists to position the planes for faster painting. Rollout is made directly onto tie-downs on the main ramp.

In looking to the future, Howard Piper was blunt in his prognosis: "We can develop planes faster than production or sales can handle them."

Cherokee Design

The Cherokee will be considered as Piper's new model for 1961, although its rollout came this year, two years after the go-ahead and what Piper called a "calculated risk" to build the Vero Beach plant.

Key objective was simply to improve the Tri-Pacer and move into the fixed-gear, low-cost, low-wing field; result was the Cherokee, which resembles the Comanche. The price, according to Howard Piper, is "very close to what the Pacer would have been in 1961, if we had continued it."

The Cherokee is of all-metal construction (Piper says labor is half that expended on the Comanche) and emphasis was placed on docile flight characteristics. The plane was not available for flight evaluation at the meeting, since it still carried the experimental tag, but this docility is evident by wide spaced gear and quite thick wing.

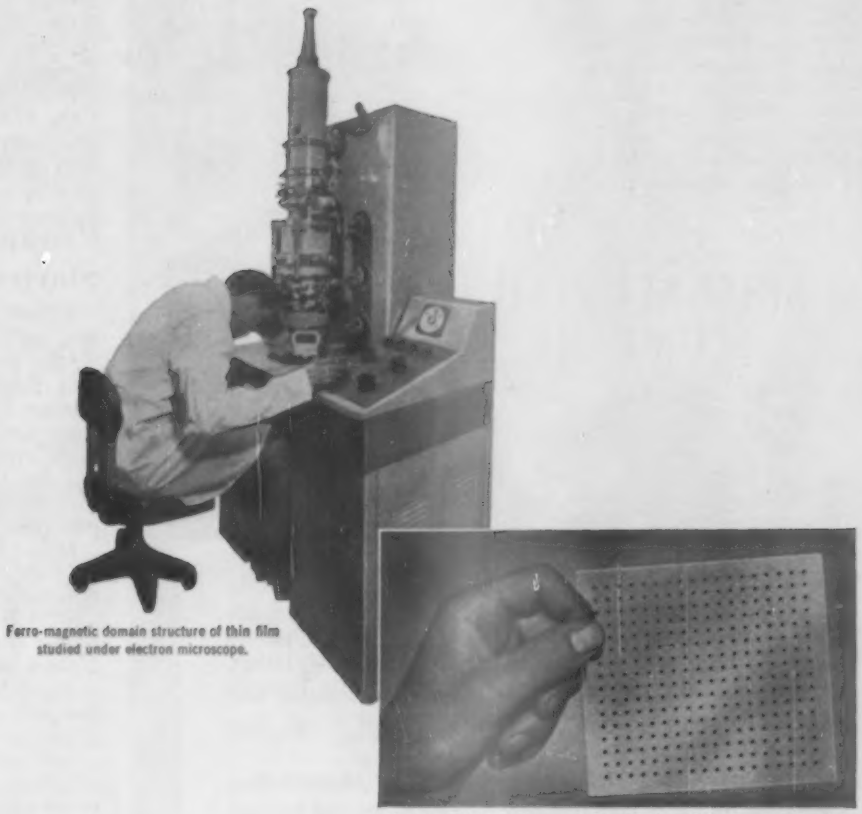
Plane will cruise in excess of 130 mph. Powerplant is a Lycoming O-320-B 160 hp. four cylinder dual-ignition engine. Standard fuel capacity is 36 gal. with additional capacity available to increase capacity to 50 gal. Fuel tanks are an integral part of the wing.

The Cherokee has a gross weight of 2,200 lb. and an empty weight of 1,185 lb., giving a useful load of 1,015 lb. This was a major design objective—stay in the Tri-Pacer weight area, but with 1,000-lb.-plus payload. Fuel consumption will be about 9 gph.

Labor costs are cut because of design simplicity; wide use of aluminum, which is less expensive than dope, fabric and tubing, and a cutback in parts, since the Cherokee has 1,200 parts, compared with 1,600 for the Tri-Pacer.

Cherokee has a large baggage compartment with a separate outside door for easy access.

Production will start in January and



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phase up to the five-a-day rate using the 160 hp. engine, although Howard Piper said the Cherokee will be offered later with a 150-hp. powerplant. Models will be Standard, Custom, Super Custom and Autoflite by late 1961.

In the regular line, the 1961 Comanche 180 and Comanche 250 will be improved and optional wing tanks offered outboard of the mains, according to Walter C. Jamouneau, Piper secretary, director and chief engineer. Tanks will increase Comanche 250 range to 1,100 mi. (still air) by giving it a 90 gal. total, up 30 from the present.

The tanks increase the weight 13 lb. but a new gross has been established for the 250, raising it from 2,800 lb. to 2,900 lb. Another new feature is a fuel drain which can be operated from the interior floor, solving a chronic complaint from owners who are forced to crawl under the low fuselage to drain the sump. Tanks can be drained in flight, if necessary. Turn radius has also been reduced from 25 ft. to 18 ft. Improvements also have been made in ventilation and heating.

Improvements to the Apache-G and Aztec twins are relatively minor. For instance, the Apache now has a new inside door lock plunger for safety purposes; it locks the inside door handle but can be opened from the outside while in the down, or locked, position. On the Aztec, throttle cables have been replaced by Teflon cables for smoother action. Ribs under the fuel cells also have been beefed up. Planes will be offered in blue, tan, green, and red, with white as the complementary color.

In most cases, Piper's 1961 models showed increased prices over 1960 planes, although the Apache-G stayed the same at $36,990. Other prices: Comanche 250, $20,485, up $685; Comanche 180, $16,445, up $645; Super Cub, $7,880, up $85, and Pawnee, $9,650, up $655. Aztec price has not been announced; plane cost $49,500 in 1960.

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Production Tooling Started for BA-7

Malmo Flygindustri of Malmo, Sweden, has started tooling for production of the BA-7 light business-sport aircraft flown by AVIATION WEEK last summer (AW June 27, p. 88). Original aircraft, designed and built by Bjorn Andreasson, formerly of Convair, San Diego, has been disassembled and shipped to Sweden for use as a prototype.

Malmo Flygindustri now is constructing three hand-built units to be used as demonstrators and for static testing, which will be to U.S. Federal Aviation Agency standards. Designer-builder Andreasson has accepted a position as chief of the aircraft division with the Swedish firm and will be responsible for other developmental work.

First delivery of a production BA-7 will be made to this country late next summer to Pioneer Aero Service of Los Angeles, representatives of Malmo Flygindustri in this country.

Projected price of the all-metal, two-place aircraft still is about $5,000.

PRIVATE LINES

Field Aviation Co., Ltd., has opened its new Aviation Executive Aircraft Center at Malton Airport, Toronto, Can. Field Aviation is headed by Douglas Kendall; Victor Koby is general manager.

First Aero Commander 500A to be based in Hawaii was flown there by Thomas H. Cooke, vice president of Aero Sales Co., Ltd., Honolulu, Hawaii, pilot, and E. A. Hickman, Reseda, Calif., navigator. Elapsed time from Oakland, Calif., was 14 hr. 32 min. for average speed of 151 kt. over the 2,186 naut. mi. route. Plane used 294 gal. of fuel.

Tennessee Aeronautics Commission has published an Airport Directory of state facilities which includes aerial

photos and details of every airport. Directory can be obtained without charge from C. E. Murray, aircraft supervisor, Tennessee Aeronautics Commission, Berry Field, Nashville, Tenn.

Welsch Aviation Co., executive and transport aircraft broker, has opened offices at the Marine Terminal at La Guardia Field, N. Y. J. C. Welsch said the move to center activities at La Guardia is part of an expansion program.

Rick Helicopters, Inc., San Francisco, has taken delivery of its second Hiller 12E helicopter. It will be used for survey and contract work in mountain areas, according to James S. Ricklefs, president.

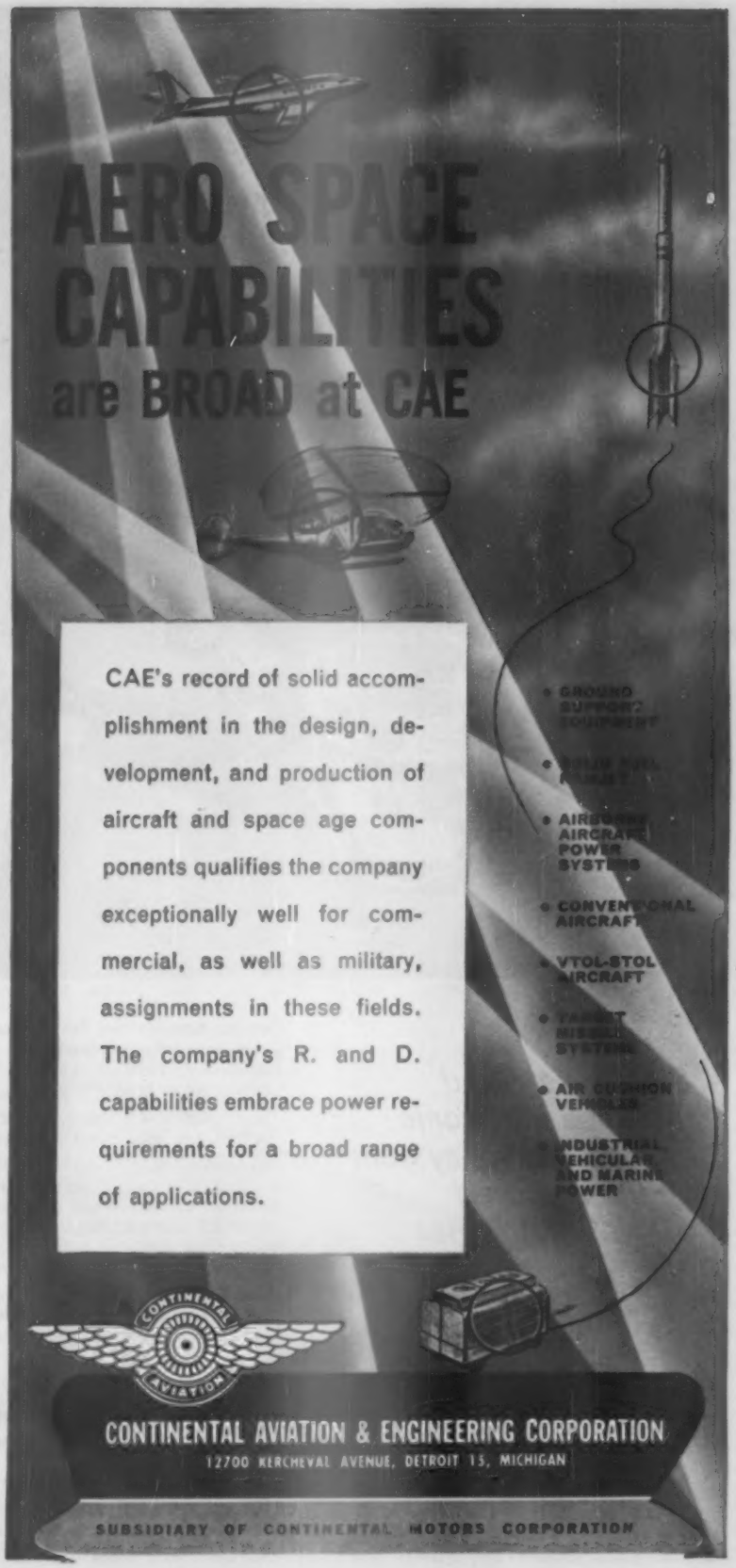
Lockheed JetStar has been ordered by T. Eaton Co., Ltd., Toronto, Can., department store organization. Company now operates a Douglas DC-3 and a de Havilland Beaver.

Monte-Copter amphibious four-place helicopter (AW May 5, 1958, p. 120) now utilizes magnesium castings, extrusions and sheets for added strength and weight reduction. Company, based at Seattle, Wash., said use of magnesium eliminated about 200 parts and 4,000 rivets. Aircraft has tip jet rotors and costs $25,000.

Beechcraft Model 18 twin has been donated to the Smithsonian Institution's National Air Museum by Red Devil Tools of Union, N. J. Plane is the first business aircraft to go on display at the museum. Plane was first built in 1946 for Continental Can and was obtained by Red Devil in 1954. Aircraft was turned over to the Smithsonian fully equipped for all-weather flying. Presentation was made by George Lee, Sr., Red Devil board chairman.

Bay Aviation Super-V Bonanza conversion (AW Aug. 22, p. 107) flew from Honolulu to San Francisco in 13 hr. 10 min., piloted by Chuck Banfe.

General Aeronautics, Inc., of Prior Lake, Minn., is using modified Republic Sea Bees, now designated Tern II, for fishing and hunting charter flights from the Minneapolis-St. Paul area. Plane is modified by L. B. Smith at Miami, Fla.; wingtips have been extended and new oil cooler has been installed. In addition, Tern II has a new splash rail to improve water takeoffs under loaded conditions. Outrigger has been added for trolling and Franklin 6A8-215-B9F engine now turns an all-metal Hartzell constant speed propeller, replacing former fiber prop. General Aeronautics is headed by Harry J. Nystrom, president.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Siegler selected to produce electronic launch control system for silo-launched ATLAS ICBM

Convair-Astronautics Division of General Dynamics and the U.S. Air Force have selected Siegler for production of the automatic electronic launch control system of the mighty Atlas. Production is now in progress under a major multi-division contract awarded The Siegler Corporation.

The Siegler team in this top-priority project includes Siegler's Hallamore, Hufford, and Magnetic Amplifiers divisions.

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COMBINED Dornier Do. 27 and Do. 28 production line at Dornier-Werke GmbH. plant near Munich. Current production of about 18 airplanes per month probably will be trimmed to 7-10 planes as Dornier tools up to produce fuselage center section of the Fiat G.91 tactical fighter being built under license for West German air force by a combine of firms for 1961 rollout.

Dornier Eyes U.S. Market for Do. 27, 28

By Cecil Brownlow

Munich—West Germany's fast-reviving aviation industry may soon launch a direct invasion into territory long considered the province of U.S. lightplane manufacturers, making a major bid for sales of the STOL Do. 27 and its twin-engine counterpart, the Do. 28, on the North American continent.

Major clearance for such a move—expected here within the next two to three months—will be final Federal Aviation Agency certification of both aircraft on a concurrent basis. British certification is expected at about the same time, and a campaign into these markets is also anticipated.

The single-engine Do. 27 already has been sold in a total of 19 countries stretching as far from home as New Guinea. Within the Americas, a Do. 27 has been sold in Brazil, and a Do. 28 is now demonstrating its short-field characteristics on a tour of South America in hopes of broadening Dornier's sales there. FAA certification will open the door to the north.

Primary sales effort within North America probably will be centered around the potential of the Do. 27 and 28 as bush planes capable of operating into the unimproved fields of Midwestern farmer pilots or from forest-surrounded clearings of the northern wilds.

Dornier officials believe the Do. 27 has proved its rugged character, including a minimum of maintenance needs, with the West German air force and private operators, and is moving to confirm a similar reputation for the Do. 28.

Aside from the South American tour, a Do. 28 recently completed a 15,000-mi. tour through Africa, including 100 landings and takeoffs from fields ranging from paved commercial strips to cornfields and jungle clearings. The aircraft, according to Dornier, performed "above all expectations," experienced "no problems" and began and completed the trip "on schedule."

The price also should be a competitive factor. The export price quoted here for a standard version of the latest version of the Do. 27, the Q5 powered by a 270 hp. Lycoming GO-480-B1A6 engine, is 117,000 DM, or slightly more than $28,000. Export price for the Do. 28 powered by two 250 hp. Lycoming O-540-A1D engines is quoted at 196,000 DM, approximately $47,000.

Thus far, Dornier has rolled off a total of 500 Do. 27s—428 of them for the West German air force as air couriers and ambulance aircraft—and 10 Do. 28s. It is currently producing at the combined rate of about 18 planes per

SHORT takeoff capability is demonstrated here by this Dornier Do. 28 twin-engine plane.

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Beech "space flights" at Boulder, Colorado . . .

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Big things are happening at Boulder. Here, near the Bureau of Standards cryogenic engineering laboratory, Beech has assembled a highly competent team of scientists, engineers and technicians, chosen for a combination of skills, experience and interests. Working with the most modern equipment (much of it Beech-developed), this team is performing vital roles in perfecting advanced propulsion systems and components. Beech qualifications for future assignments include more than 6 years experience in liquid hydrogen propellants and liquid hydrogen storage; research, development and fabrication of titanium tankage systems; and environmental testing of a wide range of missile components and systems to qualification.

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month. First delivery of the Do. 28 was recently made to a West German air taxi operator.

Production lines, however, are now being shifted to make way for Dornier's share of Germany's licensed production of Italy's Fiat G.91 lightweight tactical fighter and, unless more-than-anticipated overseas orders are received, production probably will flatten out at a combined rate of between 7 and 10 aircraft per month.

Dornier will produce the center section of the G.91 fuselage and be responsible for final assembly and flight test at its Oberpfaffenhofen Airport near Munich, where the Do. 27 and 28 have been put through their initial paces.

Competitively, Dornier is offering the Do. 27 and 28 as workhorses capable of effectively carrying out a wide range of duties—crop dusting; aerial surveys and photography, which the Do. 27 is now doing for Swissair; ambulance and rescue work, which the Do. 27 is conducting for the West German air force; glider tows, short-haul traffic and feeder service.

Operationally Similar

In addition, the company believes the short takeoff and landing and flight characteristics of both aircraft provide them with a wide sales potential and, operationally, the two are remarkably similar even for brothers, with the single-engine Do. 27 sometimes outstripping its successor.

The lighter-weight Do. 27, for example, has a useful load of 1,590 lb. as compared with 1,520 lb. for the Do. 28. It has a range of 995 stat. mi. without reserves at zero wind and 60% power at 6,000 ft. altitude as compared with 660 stat. mi. for the Do. 28 under similar conditions. Its endurance at 45% power is 9 hr., that of the Do. 28, 5:45 hr. The Do. 28, for its part, has a higher ceiling, cruising speed and rate of climb, and at the higher gross weights of each aircraft, shorter takeoff capabilities plus the attractiveness of the added margin of safety a second engine can provide.

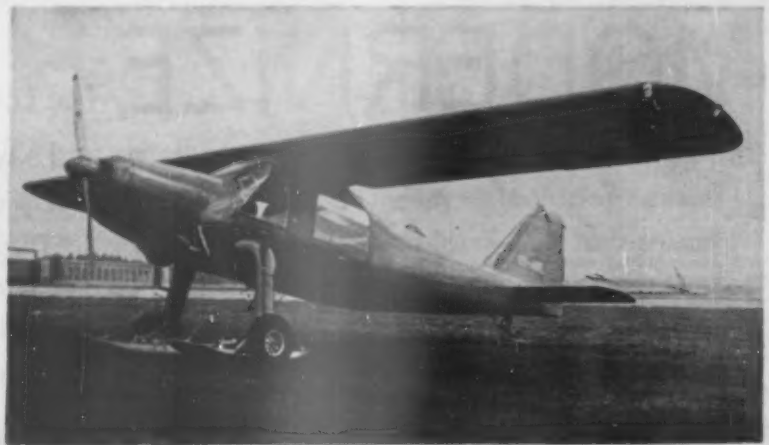
Performance Data

Comparative performance figures for the two aircraft include:

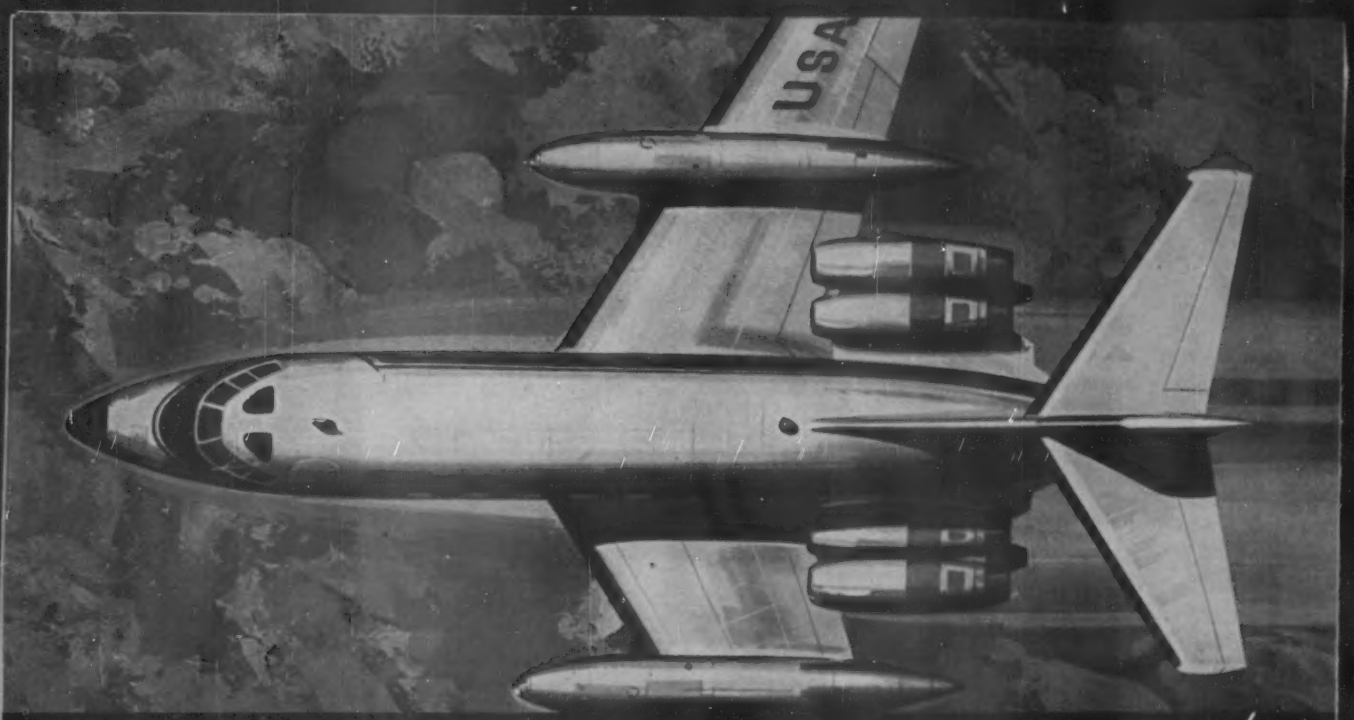
- **Fuel capacity**—Do. 27, 48 U. S. gal.; Do. 28, 121 U. S. gal.
- **Wing span**—Do. 27, 39.4 ft.; Do. 28, 46.4 ft. Additional Do. 28 span is due primarily to the inclusion of an additional fuel tank at the junction of the wing sections above the fuselage.
- **Length**—Do. 27, 31.5 ft.; Do. 28, 29.6 ft.
- **Empty weight**—Do. 27, 2,490 lb.; Do. 28, 3,610 lb.
- **Cruising speed** at 75% power at 6,000 ft.—Do. 27, 140 mph.; Do. 28, 162 mph.
- **Maximum speed at sea level**—Do. 27,

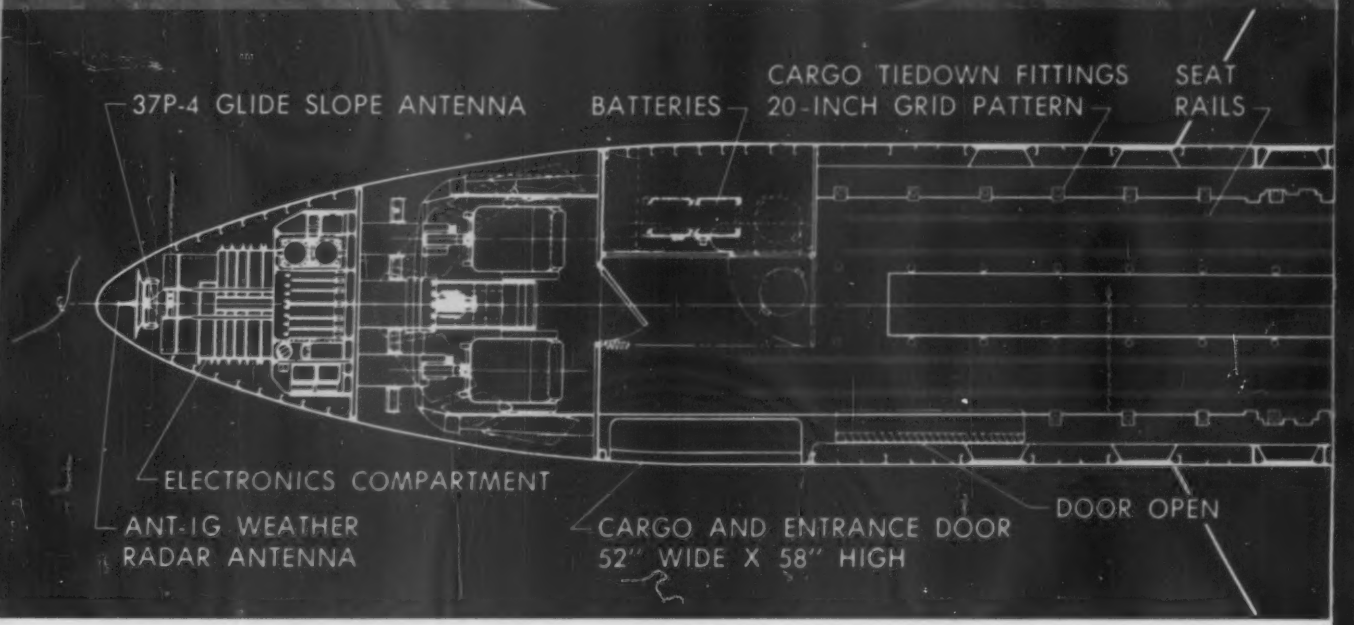
CROP dusting configuration of Do. 27 has spray unit slung behind the landing gear.

FITTED as an aerial ambulance, this Do. 27 has been sold to West German air force.



SKIS attached to the main landing gear have been added to this Do. 27 for bush work.





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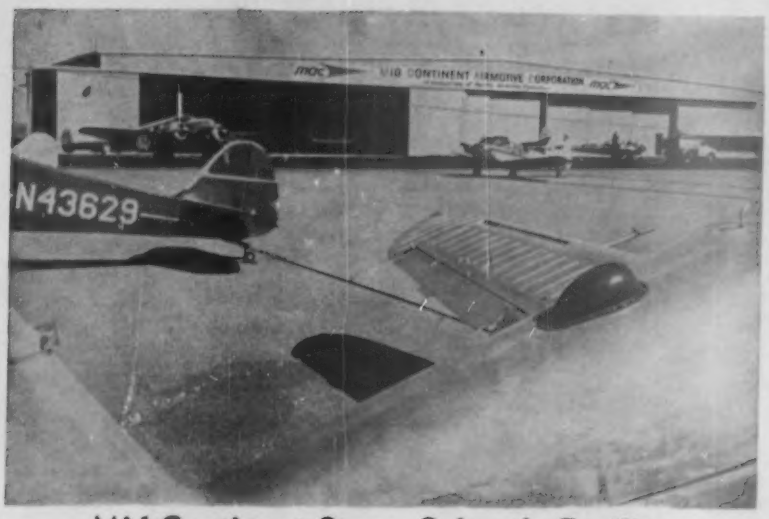

Mid Continent Opens Colorado Facility

Mid Continent Airmotive Corp. opened new facilities at Jefferson County Airport, 15 mi. northwest of Denver, Colo., as part of airport dedication ceremonies. Facility includes 33,600 sq. ft. hangar and 17 T-hangars. H. A. Smith is president and J. M. Staker is branch manager. New airport has a 6,000 ft. runway; manager is George Nelson.

152 mph.; Do. 28, rated at 171 mph.

- **Stall speed** at rated power and 45 % flaps—Do. 27, 31 mph.; Do. 28, 34 mph.
- **Approximate service ceiling**—Do. 27, 13,000 ft.; Do. 28, 20,500 ft.
- **Rate of climb**—Do. 27 at 3,970 lb. gross weight, 3,000 ft. in 6 min; Do. 28 at 5, 130 lb. gross weight, 3,000 ft. in 2.4 min.

For a takeoff run, the Do. 27 requires 610 ft. of roll and 935 ft. to clear a 50-ft. obstacle at zero wind at 4,090 lb. gross weight, while the Do. 28, at 5,130 lb. gross weight, needs only 560 ft. and 900 ft. respectively.

At lower gross weights, however, the Do. 27 moves into the lead.

With an 8 kt. wind and a lower gross weight—3,310 lb.—the Do. 27 can become airborne after a 210-ft. roll, clear a 50-ft obstacle within 410 ft. The Do. 28 with an 8 kt. wind but retaining its 5,130 lb. gross weight needs a roll of 440 ft., a total of 790 ft. to clear a 50-ft. obstacle.

Landing at a gross weight of 3,750 lb. and zero wind, the Do. 27 can come to a stop within 261 ft. The Do. 28, at 4,700 lb. gross weight, requires 355 ft. of runway under the same conditions.

The prototype of a potential successor—the Do. 29—has taken off in zero wind conditions after a 115-ft. takeoff roll and come to a halt after landing under the same conditions between 80 and 85 ft. from the end of the runway.

The Do. 29 prototype is a twin-engine pusher design in which the propellers are swiveled downward to provide lift during takeoff. A single shaft working from one gear box ensures against the possibility that a malfunction could throw the aircraft off course by swiveling one propeller downward while the other remained stationary facing aft.

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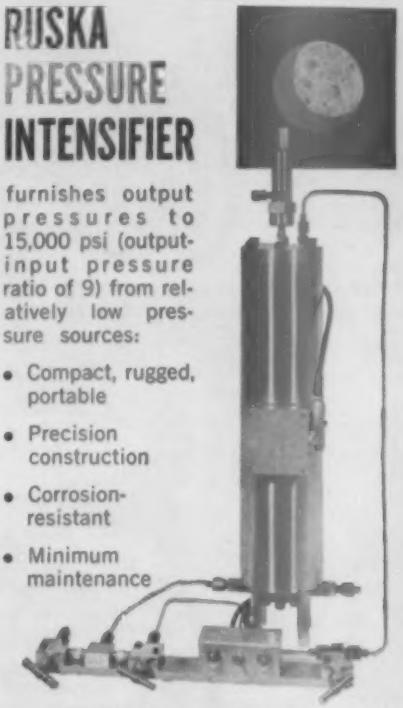

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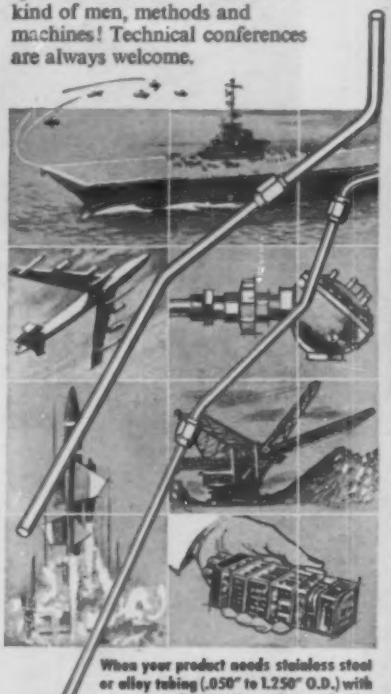

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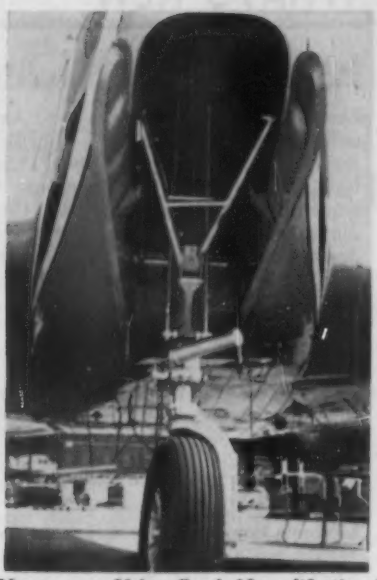
Rausch Star Beech 18 modification has enlarged cabin and costs about $125,000. Plane can seat up to 10 passengers; ceiling has been raised 11.5 in. Nose has been lengthened 3 ft. to accommodate the nose gear. Rausch is considering installing Boeing 520 turboprop engines and new Lycoming 720 eight-cylinder engines on future models.

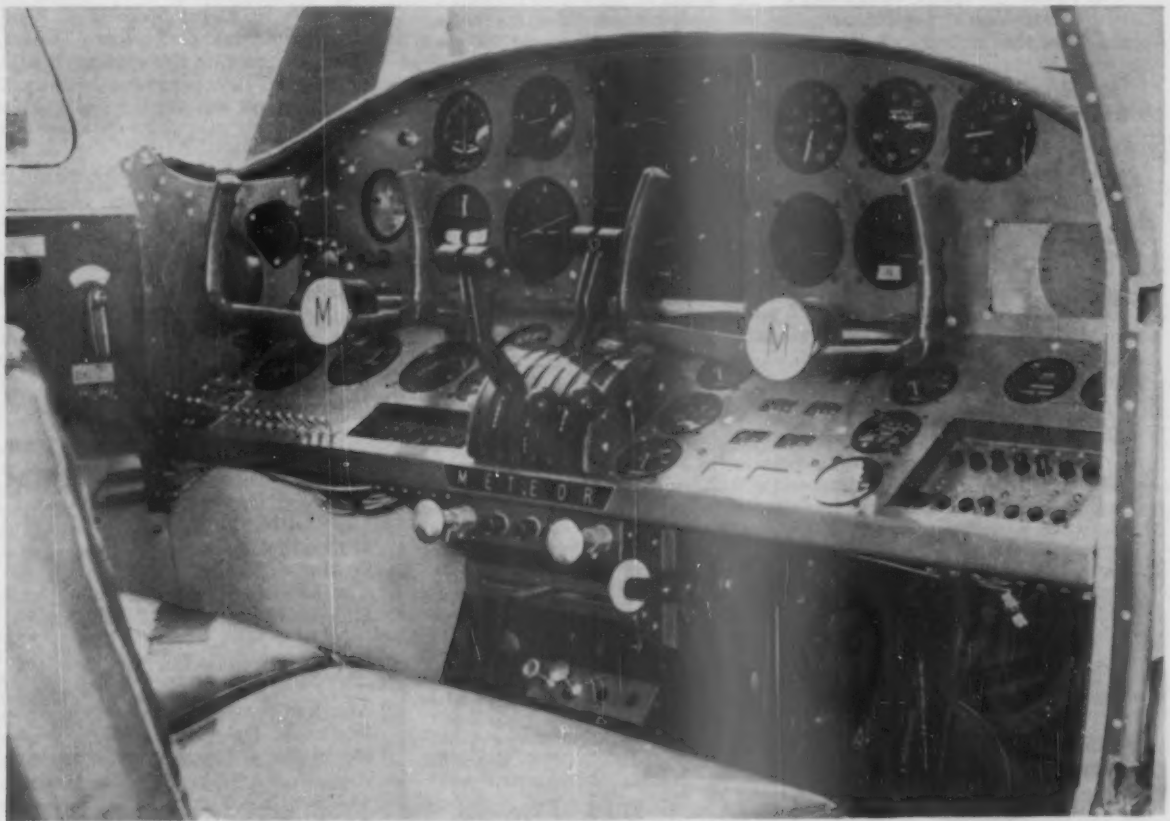
Design Details of Three Modified Executive Twins

Volpar modification of a Beech 18 (reworked C-45G) is confined to addition of tricycle landing gear which will be available in kit form. Modification will increase gross weight less than 130 lb. Gear is electrically actuated and all wheels are covered by doors.

Saturn Meteor II light-twin, five-place, design is derived from a former Monocoupe Corp. project. Powerplants are two 180 hp. Lycoming O-360-A1As turning Hartzell propellers. Gross weight is 3,800 lb. and plane cruises at 199 mph. at 75% power; range is 1,100 mi. on 120 gal. of fuel. Isothalic Fiberglas is used extensively on nose section and vertical fin.



Nose gear on Volpar Beech 18 modification (left) is tied to two shear beams to transmit loads to the monocoque structure. Standard nose gear in Volpar design is not steerable, although this feature can be provided as optional equipment. New gear is counterbalanced and retraction takes less amperage than standard landing gear. At center is nose gear on the Rausch Star, which is tied to four main fuselage beams. Note X-links for closing doors; gear retracts rearward and is controllable 35 deg. on either side. Main gear on the Volpar twin (right) is tied to a truss bolted to the normal main spar, plus additional members fitted in the center wing to take care of added torsional loads. All three wheels retract in 8 sec. Note how the gear door is cupped to provide a cover for the wheel.



Instrument panel mounted in the Saturn Meteor II has dual controls, centered throttles and propeller controls; radio panel also is centered. Engine gages are placed on a sloping panel below the main panel. Planes were modified by Saturn Aircraft & Engineering, Oxnard, Calif.; Volpar, Inc., Pacoima, Calif., and Rausch Engineering, Ltd., San Francisco, Calif.

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WHAT'S NEW

Publications Received:

Design of Concrete Pavements for Airports—Wire Reinforcement Institute, Inc., Dept. AP-11, 1049 National Press Bldg., Wash. 4, D. C. No charge if requested on company letterhead. This illustrated book contains 96 pages of descriptive information, data, tables of aircraft loading and landing gear details.

Basic Human Factors for Engineers—Paul A. Verdier—Exposition Press, Inc., 386 Fourth Avenue, N. Y. 16, N. Y. $4.00; 112 pp. Topic is designing of equipment and systems for human usage. Illustrations of task analysis, human-factors working forms and personnel evaluation are some items covered.

Motorola Power Transistor Handbook—Motorola, 5005 E. McDowell, Phoenix, Ariz., $2.00; 200 pp. Intended to serve as a guide and reference to versatile power transistor applications. A list of symbols and abbreviations in general is included.

International Political Implications of Activities in Outer Space—The Rand Corp., 1700 Main Street, Santa Monica, Calif. A report on the conference held in October, 1959, which was sponsored by Rand and the Rockefeller foundation.

Aviation Training Films—International Civil Aviation Organization, Montreal, Can. Reprint of Part 12 of the ICAO Training Manual.

Aviation Mechanics—Board of Education, City of New York—For use in vocational high schools to prepare students to take examination in either airframe or powerplant mechanics in order to be certificated for the FAA license of competency.

Aviation Cartography—Card Division, Library of Congress, Wash. 25, D. C. $1.75. A historic-bibliographic study of aeronautical charts.

The Manned Missile—Ed Rees—Duell, Sloan & Pearce, Inc., 124 E. 30th St., N. Y. 16, N. Y., $3.50; 182 pp. The story of the North American B-70.

American Strategy for the Nuclear Age—Walter F. Hahn and John C. Neff—Doubleday & Co., Inc., 575 Madison Ave., N. Y., N. Y. $1.45 pocketbook; 455 pp. A collection of 33 essays by American statesmen, scholars, military experts and international businessmen presenting an analysis of Communist vs. Free World strategy.

CAB Accident Investigation Report:

Engine Cylinder Failure Caused Crash; CAB Cites Plane Scheduling

A Pacific Air Lines DC-3, N 67589, crashed near the Santa Maria Airport, Santa Maria, Calif., while making an emergency landing following takeoff at approximately 2018 PST, Oct. 26, 1959. The copilot was killed, the captain was seriously injured, and the purser and 17 passengers received injuries of varying degrees. The aircraft was substantially damaged.

Flight 308 was scheduled between Los Angeles, and San Francisco, with intermediate stops at Oxnard, Santa Maria, and Paso Robles, Calif. The trip to Oxnard and Santa Maria was routine. Takeoff from Santa Maria was made from Runway 30 with 17 passengers on board and a crew of three. A few seconds after the first power reduction following takeoff, a loud explosion was heard and fire was seen in the left engine. The left propeller was immediately feathered, the engine was shut off, and appropriate power was applied to the right engine. At the time this happened the aircraft was at an approximate altitude of 550 feet msl., or 300 ft. above the ground. Shortly after this the fire was observed to be out; however, the airplane began to buffet. This buffeting became so severe that the aircraft lost altitude and the captain was forced to make an emergency landing about 1½ mi. north of the airport.

The Board concludes that this accident was caused by the failure of the No. 5 cylinder of the left engine in flight, resulting in the distortion of the ring cowling to an extent that made flight impossible.

Investigation

On Oct. 26, 1959, N 67589, a Douglas DC-3, owned and operated by Pacific Air Lines, was dispatched by the company as Flight 308, a scheduled flight between Los Angeles and San Francisco. Intermediate scheduled stops were to be made at Oxnard, Santa Maria, and Paso Robles, Calif. The crew consisted of Capt. Charles W. Craig, First Officer Joseph J. Flanigan, and Purser Donald F. Robesky. First Officer Flanigan was acting as captain and riding in the left seat throughout the flight.

The flight from Los Angeles to Oxnard and Santa Maria was made without incident. Flight 308 landed at Santa Maria at 1945[1] and passengers and cargo were unloaded. While these operations were being performed, a station agent called First Officer Flanigan's attention to the left engine which was leaking oil. First Officer Flanigan left the aircraft and examined the engine by means of a flashlight. He returned to the cockpit and advised Capt. Craig that everything seemed to be all right and that no more oil was present than one would normally find on an engine. Further, not enough oil had leaked to cause any to be added. The captain, who had looked at the left engine from the cockpit window, agreed that the leak was not sufficient cause to interrupt the flight.

When the refueling was completed and the flight was ready to go, a normal engine start was made and the airplane was taxied to the takeoff point. Cockpit and magneto checks were normal and the takeoff was made at 2016 from Runway 30. The gross weight of the aircraft at the time of takeoff was 24,071 lb., which was below the maximum allowable gross takeoff weight of 25,346 lb. The aircraft was loaded within prescribed limits with respect to the center of gravity. There were 17 passengers, including one infant, on board.

A few seconds after the aircraft became airborne and the first power reduction was made, a loud explosion was heard and fire was observed in the left engine. The landing gear and flaps were in the up position at the time. Capt. Craig immediately pushed the feathering button to feather the left propeller, determined that the right engine was operating on METO power (maximum except takeoff), and closed the left throttle. He then took control of the aircraft. The altitude at that time was 550 ft. msl. (approximately 300 ft. above the ground), the airspeed was 91 kt., and the aircraft was in a right turn. The captain stopped the turn and attempted to climb or at least hold what altitude he had. He then asked Mr. Flanigan to check and see if the gear and flaps were up and if the carburetor heat control was in the cold position. This was done and the first officer said, "I will take care of the fire in the left engine," and reached for the fire control box.

Plane Buffeting

By then the aircraft was buffeting badly and the captain asked the first officer to see if the left propeller had feathered properly because he thought the buffeting might be caused by a slowly windmilling propeller.

Flanigan looked out of the left window and placed his hand on the feathering button. He then reported that the propeller was feathered. The cowl flaps were checked and found to be in the trail position. With the buffeting becoming worse and the aircraft losing altitude, the right throttle was moved forward for full power. In a short time Capt. Craig said that he knew that a crash landing was imminent and seeing the silhouettes of oil derricks ahead and above him, he turned the airplane to the left in an effort to avoid them.

The airplane struck the ground almost immediately.

The place of impact was about 1½ mi. north of the Santa Maria Airport at an elevation of 230 feet msl. With the aircraft in a left-wing-low attitude, first ground contact was made by the left wing tip. The aircraft cartwheeled to the left on its nose and in doing so the left elevator struck a 12,000-v. powerline causing power to be disrupted over a wide area; there was no fire. The aircraft came to rest on the bottom of its fuselage after sliding rearward approximately 65 ft. on a small embankment near a macadam road; it was heading 145 deg. magnetic.

After the aircraft came to rest, Purser Robesky was able to free himself from his seat, which had become detached from the floor and had inverted. He immediately opened the main cabin door, through which the passengers were deplaned. First Officer Flanigan was thrown clear of the wreckage and was found strapped in his seat. Capt. Craig, after freeing his foot which was caught in the debris near the right rudder pedal, left the aircraft through a large opening which had been made in the left front of the nose.

After the accident, it was learned that at 2017 the Los Angeles Air Traffic Control Center heard the following transmission from Flight 308 on 124.0 megacycles: "Santa Maria, Pacific 308, we're coming around and land." This was the last message from the flight. The Santa Maria Airport does not have a control tower.

The weather at the time of the accident was: 1,500 ft. overcast; visibility 7 to 8 mi.; wind west at 6 kt.

Wreckage Examination

All of the aircraft structure, powerplants, and propellers were found either near the main wreckage site or on or adjacent to Runway 30. Parts found on the runway were from the left engine, its cowling, and from the No. 5 cylinder and associated structure.

The left engine was torn free of the aircraft by impact forces. It was found minus its cowling in the vicinity of the main wreckage. Examination disclosed that the No. 5 cylinder had separated from its base at a point about 1¾ in. above the base flange or near the fourth or fifth fin from the bottom of the cylinder. This area is covered by cylinder baffles and is in the rear row of twin rows of cylinders. The No. 5 cylinder was found near the main wreckage and it is believed that it remained in the cowling until the left wing contacted the ground and the aircraft started to cartwheel to the left; both valves and spark plugs were in position. The piston parts and piston pin with a portion of the connecting rod attached were found on the runway. The piston head had a deep circular gash in it which fitted the broken edge of the cylinder wall of that portion which separated from the base. The piston parts bore evidence of having been subjected to severe forces which had broken and cut the piston into various pieces. The engine's rear power section was severely damaged. The case was punctured, the link rods were

[1] All times herein are Pacific Standard based on the 24-hr. clock.

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broken, and the cylinder skirts were flared. The engine's rear master rod and crankshaft could not be moved.

The front row master and link rods were in normal condition. There was evidence of fire around the rear and upper portions of the engine and the accessory cowling behind these areas. The left engine's cowling, both main and accessory section, was damaged by the failure of the engine and by impact with the ground. Seven small round rubber mounts used as cowling supports were found on the runway; the first was found only 1,900 ft. from the takeoff end. A rectangular rubber rocker box pad, which matched the cowl fastenings at the No. 5 cylinder position Dzus fasteners, a cowling hook, a 10-in. section of the heater ram air scoop, and a section of cowl flap were also found on the runway. The accessory cowling section was the more extensively damaged. This section bore evidence of intense heat and some blistering. A section of the top of this cowl with the ram air scoop for the carburetor attached was bent upward and rearward at an angle near the bottom left corner. The entire accessory section of the cowl was deformed somewhat with fasteners torn out in some portions and tears in others. The propeller governor and feathering pump were checked and found capable of normal operation.

Impact Forces

The right engine also separated from the aircraft because of impact forces and was found near its nacelle. This engine suffered impact damage but examination showed that prior to impact it was functioning in a normal manner.

The left propeller was found detached from its engine. The blades were bent and damaged by impact forces; the dome was not damaged. It was determined that all three blades of the propeller were positioned at a blade angle of 73 deg. at the time of impact. To be fully feathered the blade angle should have been 88 deg.

The right propeller was also found detached from its engine. The dome and blades were damaged by impact forces. The blade angles were determined to be 23 or 24 deg. These blade angles indicate that this engine was delivering power at the time of impact.

As would be expected, the aircraft was badly damaged by impact and the subsequent cartwheel. None of the damage to the aircraft contributed in any way to the cause of the accident and therefore will not be described. It was determined that the CO_2 fire extinguisher bottle had not been used. The landing gear and flaps were found in the up position.

Aircraft Maintenance

Pacific Air Lines performed all major overhauls and all major inspections of its aircraft and components, with the exception of propellers, at the company's San Francisco base. The overhaul of propellers was done by an outside agency. At Los Angeles the company contracted with International Flight Service, a local company, to taxi and fuel its aircraft, to perform turnaround and daily inspections if needed, and to make all necessary minor repairs.

Company dispatching for the route involved was accomplished from San Fran-

cisco. Records of aircraft and engine times, etc., were kept by the maintenance department and when it was time for an aircraft to return to San Francisco for major inspections or repairs, company flight control was advised and the aircraft was immediately scheduled to return to the main base and if necessary another was sent out in its place. N 67589 had been given a 125-hr. inspection 25 or 30 hr. prior to the subject flight.

N 67589 was based at Los Angeles and therefore was under the supervision of International Flight Service with respect to maintenance.

Previous Leaks Noted

The left engine of this aircraft had a number of oil leak complaints which were entered on the flight record by several captains; these began Oct. 19 and continued through Oct. 26. Each item was initialed by a mechanic and an explanation given indicating the corrective action taken. Corrective action included the replacement of rocker seals and gaskets, rocker box covers, and the tightening of holddown nuts around the propeller governor. On Oct. 25, 1959, an item written in the log was "oil leak left engine." The explanation of the corrective action was written as follows: "Checked for oil, washed down left engine and replaced gasket and rocker box gasket." These items were initialed by the mechanic doing the work and according to International Flight Service the aircraft in each instance was considered to be airworthy.

On Oct. 26, 1959, Mr. Glen Smith, the owner of International Flight Service, had

Quick Engine Change Facility for B-52H

Test stand providing quick engine change capability for Strategic Air Command units getting the new B-52H has been developed by Wichita Division of Boeing Airplane Co., for the airplane's Pratt & Whitney Aircraft TF-33 turbofan engines. Stand makes possible off-the-airplane testing of the complete TF-33 power package, including accessories, so that it can be installed quickly after check, to replace a faulty powerplant. Specially designed stand takes into account the turbofan's eccentric flow thrust, which provides a torque requiring special fittings on the stand to restrain the engine during runups. Air Force and civilian officials from major USAF commands recently inspected the new stand during a demonstration at Boeing-Wichita.

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WORK IN THE CLIMATE OF ACHIEVEMENT

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the following teletype message sent to the company's San Francisco office: "Maint. Boller req that shp 110 be used on Flt. 308/DTE in order to get it back to SFO. Has oil leak in left engine which we have been unable to stop LAX-RR/IFS/ 1243/ 26BOB."

At 1252, Oct. 26, 1959, the following message was received from Pacific Air Lines flight control: "LAX-K-WL Plan 110 on Flt 308 X 1252/26H." Accordingly, ship 110 was scheduled as directed.

Mr. Smith testified that his organization had done everything it could to find and stop the oil leaks under the limitations of their contract. He said that the night before the flight was scheduled the engine was washed down and the above corrective action taken; the cowling was then left off overnight in order to be able to see any oil which may have leaked during the night. None was found the next morning and the engine was then run until it was hot to see if oil might leak under this condition. Again no leak was found and accordingly the cowling was put on and the aircraft made ready for flight. Mr. Smith further said that he considered the engine to be airworthy.

Maintenance facilities of the company in San Francisco were very good, the shops were well equipped and manned by trained personnel, and an adequate supply of parts was stocked. In Los Angeles this was not the case; proper records were not kept (no recent daily inspection forms were found for this aircraft after the accident) and pilots complained that an inadequate supply of parts was maintained. Mr. Smith testified that although the company did not always furnish them the required inspection forms, all inspections were made as required and all work was performed by certificated mechanics in the same manner it would have been done if they had the forms.

Analysis

The question arises, should N 67589 have been dispatched as a scheduled flight the day of the accident in the light of its history of oil leaks?

The company had knowledge of the trouble with this engine from two sources—i.e., engine and aircraft records that are maintained in San Francisco and which should be kept up-to-date daily, and from the message sent by International Flight Service to the company from Los Angeles which clearly requested that the aircraft be returned to the main base because of an oil leak that could not be stopped. Knowing that oil leaks are often the forerunner of serious engine trouble, the Board believes that both the service company and the airline should have taken definite steps to determine that the engine was airworthy before allowing the aircraft to be used on a scheduled flight.

Since this was not done, the Board believes that when the crew found the oil leak at Santa Maria to be of a magnitude sufficient to cause the concern of a fellow company employe, the aircraft should have been delayed until the source of the trouble was determined.

There is no doubt that the No. 5 cylinder of the left engine failed and that this failure occurred only seconds after takeoff. Proof of the time of the failure lies in the fact

that engine and cowl parts belonging to this engine were found on the takeoff runway after the accident occurred. The time of the failure is most important because it indicates that it occurred very soon after takeoff before any appreciable airspeed and/or altitude had been gained, and therefore narrows the field of possible corrective action which could have been taken by the crew.

It is recognized that this engine's ring cowl was badly deformed as a result of this failure and that a section of it was displaced upward and rearward. The Board believes that the deformation of the cowling disturbed the airflow over the center section and the empennage sufficiently to cause both a severe buffet and a serious drag condition.

Conclusion

The Board therefore concludes that the pilot was unable to maintain altitude and return to the airport because of conditions beyond his control affecting the flying characteristics of the aircraft.

As a result of this accident, the company decided to send its own maintenance personnel to Los Angeles to perform all future work on company aircraft.

The Board determines the probable cause of this accident was that following the failure of the left engine, the left engine's ring cowl was deformed causing a buffeting and drag condition which made sustained flight impossible. A contributing factor was the scheduling of the aircraft by the company when there should have been reasonable doubt concerning the airworthiness of an engine.

By the Civil Aeronautics Board:

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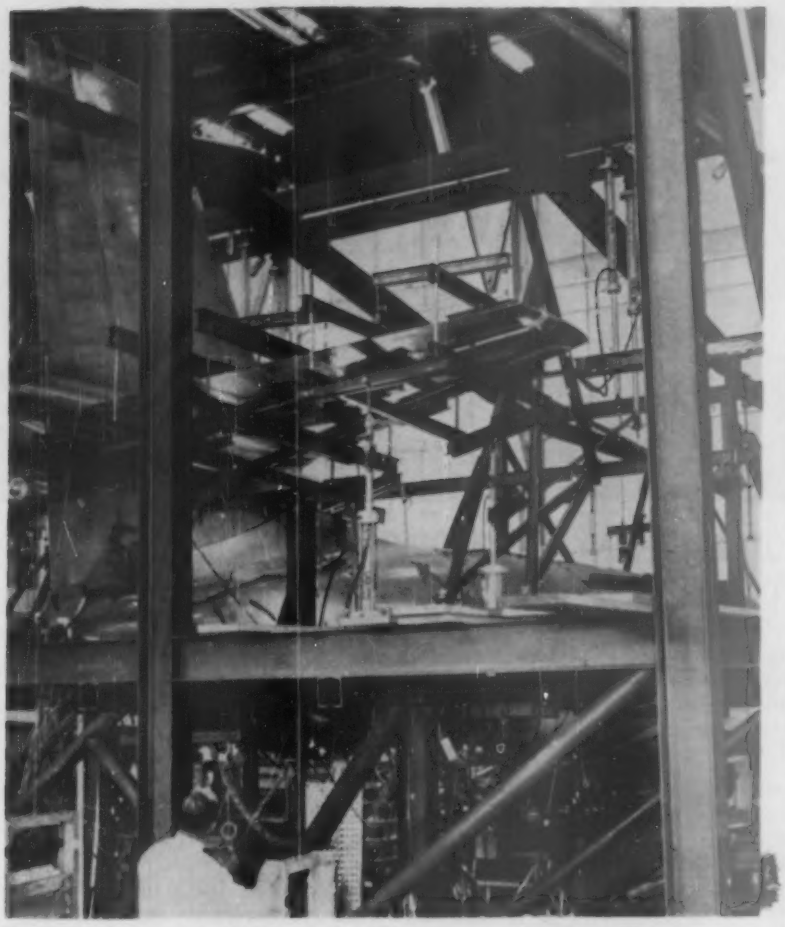
Supplemental Data

The Civil Aeronautics Board was notified of the accident at 2200, Oct. 26, 1959. An investigation was immediately initiated in accordance with Section 701 (a) (2) of the Federal Aviation Act of 1958. Depositions were ordered by the Board and were taken in Inglewood, Calif., Dec. 2, 1959,



Lockheed JetStar Undergoes Stress Tests

Lockheed JetStar undergoes stress tests at Lockheed's Marietta, Ga., facility. Weights and pulleys are bending the horizontal stabilizer to the extreme limit as part of Federal Aviation Agency certification program to test the aircraft's structural integrity.

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Write C. H. Lang, Director of Employment, The Martin Company, Orlando 2, Fla. (For Career Opportunities, see facing page.)

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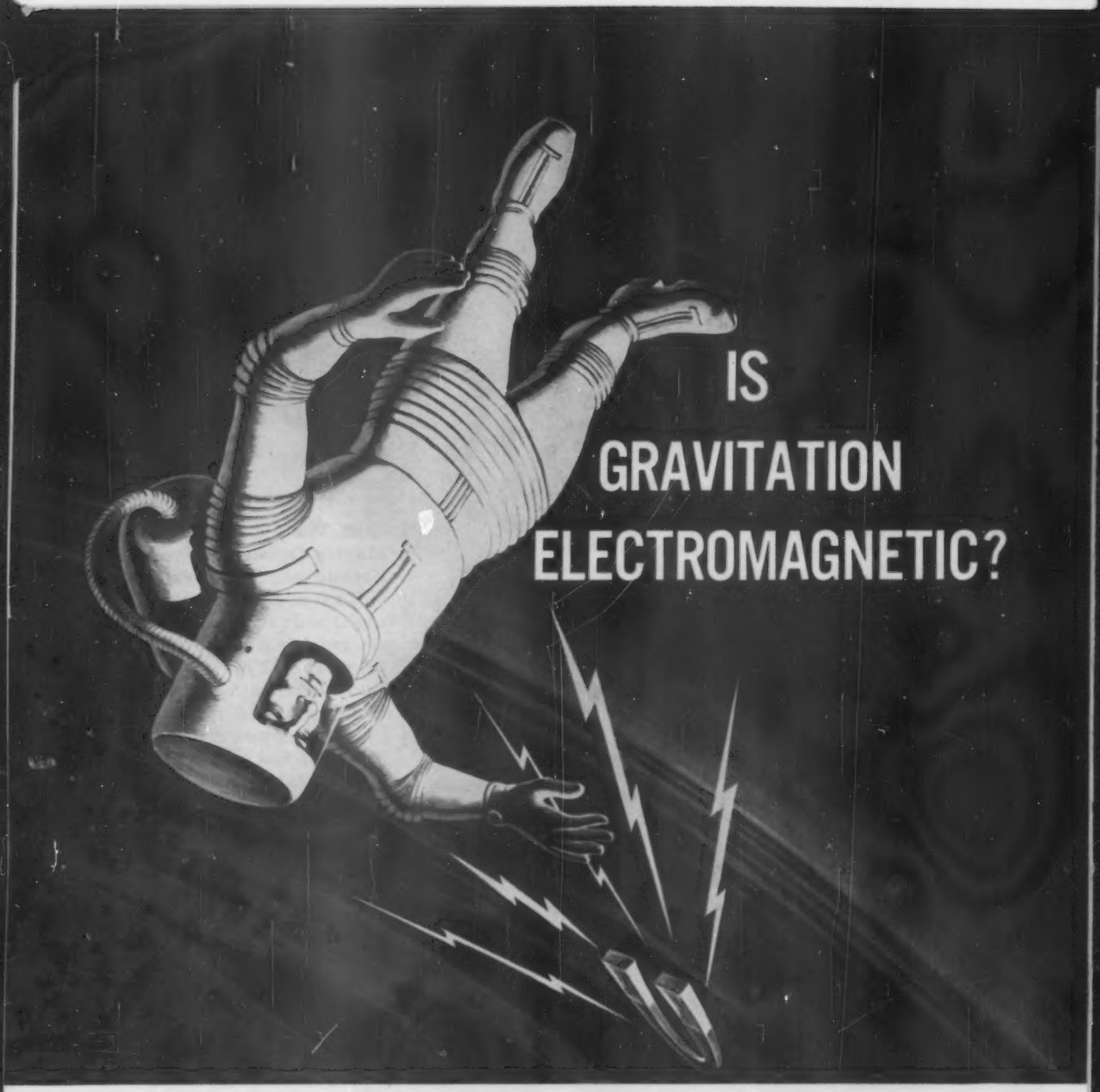

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and San Francisco, Calif., Dec. 3, 1959.

Pacific Air Lines, Inc., is an Arizona corporation with its principal office in San Francisco, Calif. The corporation operates as an air carrier under a certificate of public convenience and necessity issued by the Civil Aeronautics Board and an operating certificate issued by the Federal Aviation Agency. These certificates authorize the carrier to engage in air transportation of persons, cargo, and mail within the United States.

Flight Personnel

Capt. Charles W. Craig, age 40, was employed by Pacific Air Lines Nov. 11, 1946, as a first officer. He was promoted to captain and later to check pilot. He held an airline transport pilot certificate with DC-3, Martin 202 and 404, and Fairchild F-27 type ratings. His last proficiency check was taken Mar. 23, 1959. His last FAA first-class medical examination was taken Oct. 20, 1959; there were no limitations. He had a total of 17,467 flying hours, of which 14,467 were in the DC-3 aircraft.

First Officer Joseph J. Flanigan, age 31, was employed by the company Jan. 10, 1956. He was in the process of being upgraded to captain at the time of the accident. He held a valid commercial pilot certificate with airplane single-engine land, multi-engine land, and instrument ratings. His last FAA medical examination, first-class, was taken Jan. 15, 1959. He had a total of 3,951 flying hours, of which 3,032 were in the DC-3 aircraft.

Purser Donald F. Robesky, age 31, was employed by the company Sept. 25, 1951.

The Aircraft

N 67589, a Douglas DC-3, serial number 19656, was owned and operated by Pacific Air Lines, Inc. The aircraft had accumulated a total of 24,805:54 hr. since new and 12,908:54 hr. since major overhaul. It had 31:45 hr. since last line maintenance. The aircraft was equipped with two Pratt & Whitney R-1830-92 engines. The left engine had 990:18 hr. and the right engine 595:05 hr. since overhaul. The propellers were Hamilton Standard, Model 23E50.

WHO'S WHERE

(Continued from page 23)

Changes

General Electric Co.'s Missile and Space Vehicle Department, Philadelphia, Pa., has announced the following appointments: **J. Pieter deVries**, manager of astrodynamics, Space Sciences Laboratory; **L. W. Warzecha**, project manager, feasibility study group for Project Apollo; **E. J. Merrick**, project engineer, Project Apollo studies; **William L. Davis**, manager of MSVD's Army and Navy sales.

Harold E. Kren, manager of the recently formed Monterey (Calif.) Laboratory of Laboratory for Electronics, Inc., Boston, Mass. Other Monterey Laboratory appointments: **Donald F. Criley**, manager-computer systems group; **Benjamin L. Schwartz**, manager-systems analysis group.

Carl F. Schunemann, head of a newly established electronic products department, The Martin Co.'s Electronics Division, Baltimore, Md. Also: **Donald W. Kalkman**, director of quality control, Electronics Division.

Ford Motor Co.'s Aeronutronic Division, Newport Beach, Calif., has announced the following appointments within Space Systems Operations: Penetration Systems—**Charles G. Gant**, manager, and **Dr. Harold N. Hall**, assistant manager; Projects—**John S. Mills**, manager; Design, Fabrication and Field Service—**Arthur C. Haines**, manager. Also: **James A. Ambrose**, technical adviser to the general operations manager; **James E. Heywood**, manager of programing and controls.

George D. Howland, contract manager-aerospace group, Hughes Aircraft Co., Culver City, Calif., succeeding **William Van Allen**, now materiel manager for Hughes' manufacturing division, El Segundo, Calif.

Joseph Rambusek, sales manager, The Siegler Corp.'s Magnetic Amplifiers Division, New York, N. Y.

Dr. William N. Breswick, manager of management analysis, Lockheed Missiles and Space Division, Sunnyvale, Calif.

Arthur E. Rowland, chief-sales engineer for armament and flight control products, Autonetics, a division of North American Aviation, Inc., Downey, Calif.

H. H. Sommer, chief design engineer, and **C. L. McCabe**, chief project engineer, Convair-Pomona (Calif.), Convair Division of General Dynamics Corp.

Frederick E. Rushlow, director of marketing, Giannini Controls Corp., Duarte, Calif., and **Lawrence M. Ryan**, general sales manager. **R. Joseph Thompson** succeeds Mr. Ryan as Western regional sales manager. Also: **Walter B. Helms**, manager of Giannini's Pasadena (Calif.) Transducer Division, succeeding **C. A. Mounteer**, who was appointed to corporate staff of Giannini's vice president and director of engineering.

W. L. Whittier, works manager, Douglas Aircraft Co.'s Long Beach (Calif.) Division, and **Howard W. Cleveland**, manufacturing control manager.

James M. Cryer, Jr., manager, Applied Science Division of Melpar, Inc., Watertown, Mass., and **Dr. Arthur Kohlenberg**, technical director.

Milton Kuska, manager-Laminar Flow Control airplane project, Norair Division, Northrop Corp., Hawthorne, Calif. Also appointed to the LFC project: **N. A. Krause, D. D. Warner, R. E. Kosin, O. P. Omley** and **J. D. Young**.

L. H. Orpin, general manager, Stromberg-Carlson, San Diego, Calif., a division of General Dynamics Corp.

Space Technology Laboratories, Inc., Los Angeles, Calif., has announced the following appointments: **Dr. J. M. Andres**, head, Physics Section, Techniques and Components Department, Guidance Research Laboratory; **Gerard W. Elverum, Jr.**, manager, Propulsion Systems and Development Department, Propulsion Laboratory; **George H. Holmes**, manager of technical services; **Dr. Thomas A. Magness**, acting head, Guidance Systems Section, Guidance and Navigation Department, Guidance Research Laboratory; **Dr. Peter Staudhammer**, associate manager, Propulsion Systems and Development Department, Propulsion Laboratory; **Nat W. Trembath**, associate manager, Controls and Simulation Department, Electromechanical Laboratory.

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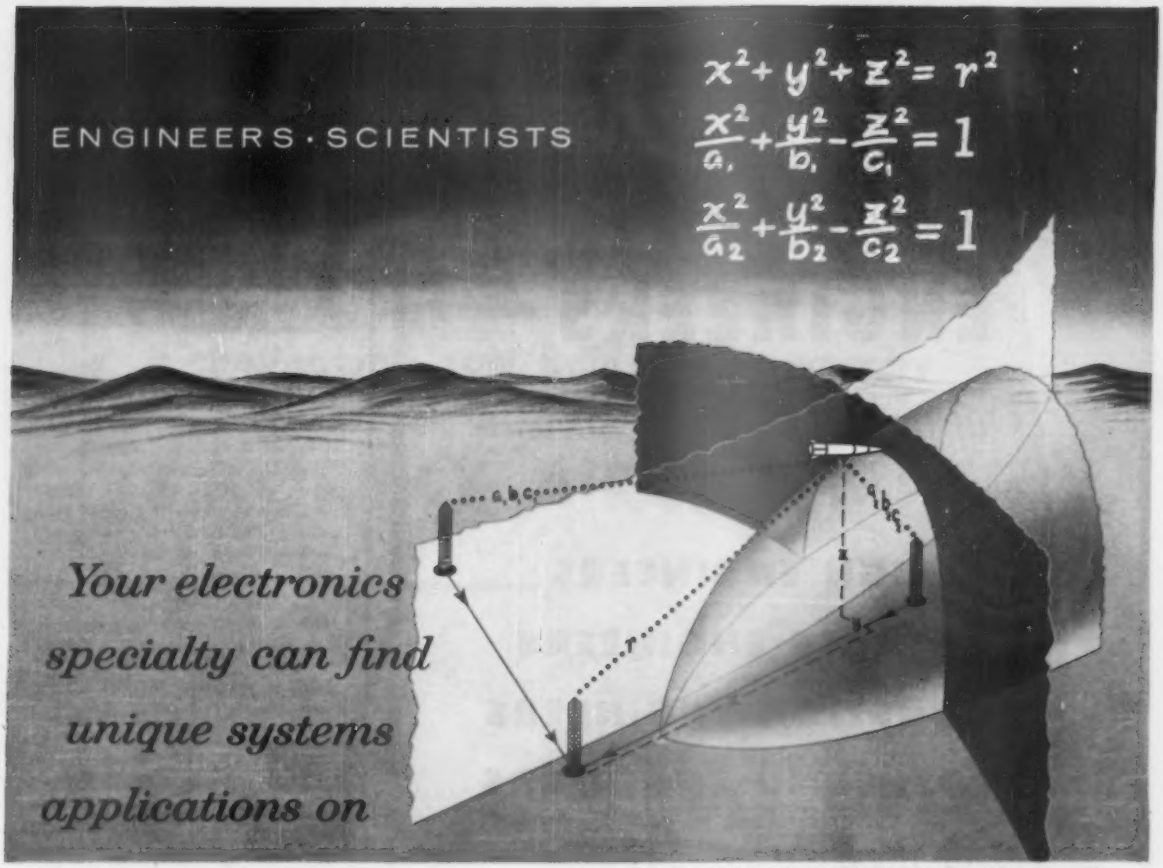

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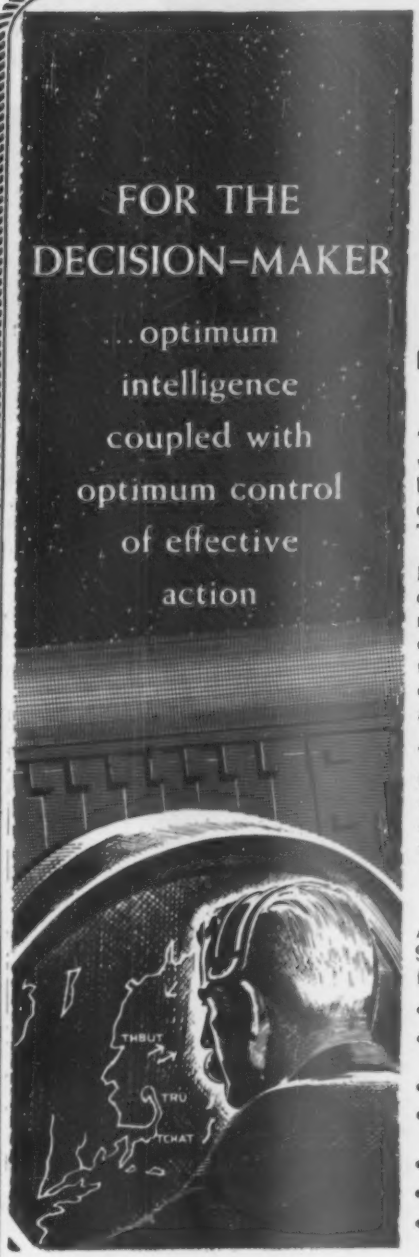

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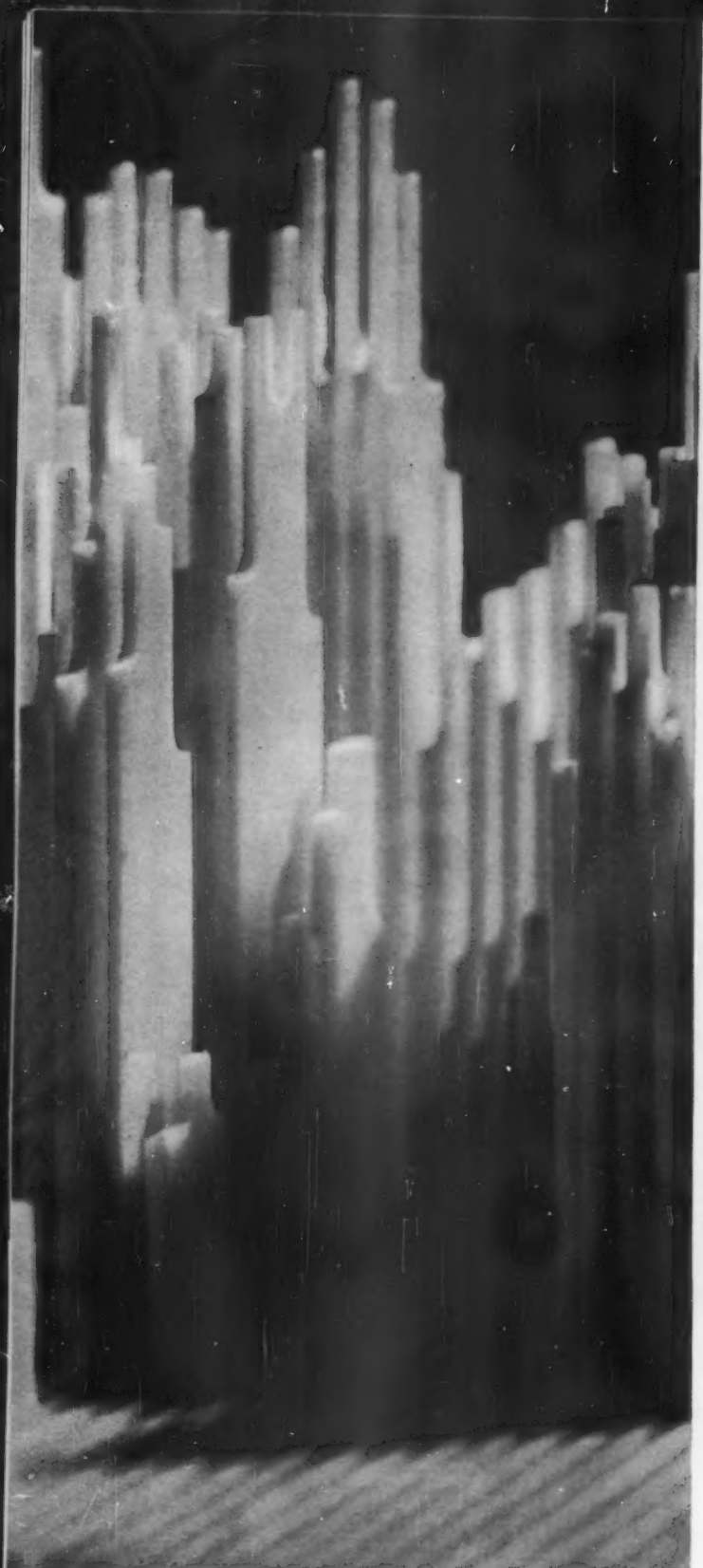

Representation of the frequency-energy pattern of the spoken word, "IBM." Horizontal axes: frequency and time. Vertical axis: energy. Sampling interval: 0.01 second.

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The plastic model shown here is a 3-dimensional representation of the frequency-energy pattern of the spoken word, "IBM." It is one of several similar models constructed from a computer analysis of speech information.

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LETTERS

West Coast Avionics

We agree with your statement (Oct. 10, p. 81) that avionics and space technology research and development activities are expanding in the San Francisco Bay Area. Your reference to Arthur D. Little, Inc., however, is somewhat misleading regarding our activities in the West.

While ADL is looking for new laboratory space in the San Francisco area, we would like to point out that we have had a laboratory in San Francisco for over six years, and opened an engineering facility in Santa Monica last year. There are over 100 ADL personnel in the West, some of whom are personnel assigned to various Air Force bases.

Our need for new facilities in the San Francisco area stems from growth and the fact that our Western Division laboratory at 314 Battery Street is in the area destined for the Golden Gateway Redevelopment Project.

CHRISTIAN J. MATTHEW
Manager, Western Division
Arthur D. Little, Inc.
San Francisco, Calif.

Haynes Name

Since the inception of space terminology, our company has been jokingly mispronounced. Not until your Oct. 17 issue appeared, however, had the writer seen the error in print. On p. 122 a picture caption reads, "Close Tolerances for Jet Parts—Reinforcing band for jet engine is formed from alloy made by Haynes Satellite Co. . . ." The word Stellite was conceived by Elwood Haynes to describe his early cobalt base alloys which play such an important role in modern jet engines, as well as industrial progression. The writer has been a subscriber to your magazine for several years now, and would congratulate you for a continued work of excellence.

FRANK R. DICKINSON
Asst. to District Manager
Haynes Stellite Co.
Division of Union Carbide Corp.
New York, N. Y.

Radar Designers

We realize that space limitations necessarily restrict publication of many details connected with new technological achievements. However, we think your readers might be interested in identification of the designers of the world's largest radar telescope now being built at Arecibo, Puerto Rico ("Puerto Rico Radar to Probe Ionosphere," AW Sept. 19, p. 88).

They are Von Seb., Inc., architectural firm of Waverly, Pa., Praeger and Kavanagh, engineering firm of New York City; Severud-Elstad-Krueger Associates, structural engineering consultants; and Developmental Engineering Corp., communications systems designers of Leesburg, Va.

BOYNTON G. HAGAMAN
Project Engineer
Developmental Engineering Corp.
Leesburg, Va.

Aviation Week welcomes the opinions of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42nd St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

'Poison Needle' Award

Please allow me to propose the "Poison Needle" award to the man in the Budget Bureau who must have figured it out that it was cheaper to hire men that like to fly to pilot the U-2 than to incorporate devices in the plane that would have made the surveillance automatic.

DON LLEWELLYN
Burbank, Calif.

Reference a letter in your Oct. 3 issue (p. 126) anent an award on an annual basis for Francis G. Powers, let me say never, never, never. In Powers' quest to save his life he sold our country and that for which it stands right down the Volga. His was a behavior, which if practiced by a captured combat infantryman, would be judged as "aiding and comforting the enemy." Powers' sentence was very lenient and the less said or remembered about him the better.

For more enlightenment on the subject, I refer letter writer Zawiski to Columnist White.

W. C. HELLER
Flourtown, Pa.

Mr. John Zawiski's "U-2 Pilot Award" letter represents the type of thinking that is becoming more prevalent in the U.S., and was particularly disgusting to me. Mr. Powers proved only one thing—every man has a price and his was $30,000 per year. I'm sure there are many patriotic pilots in all branches of our armed forces who would have volunteered for over-flights of Russia and at no increase in pay.

In the event of capture, these pilots would have given only their name, rank and serial number.

ROBERT L. HADDOCK, JR.
Orlando, Fla.

This is in reply to the letter written by Mr. John Zawiski.

Unlike Mr. Zawiski, I was a pilot during most of my 20 years of military service and I am now employed in the aircraft industry. However, I do not consider that experience (nor Mr. Zawiski's lack of it) to be germane to the issue.

Mr. Zawiski is naive in the extreme . . . If indeed there are many Americans who believe as Mr. Zawiski does, then the implications of Francis Powers' conduct on and after 1 May 1960 have been obscured in the voluminous reporting of the flight and subsequent events. The heart of the issue was very aptly expressed by the news commentator who observed that no one should have any difficulty in separating Powers' conduct from that of Nathan Hale in 1776. Apparently, however, there is at least one who finds it difficult.

Have loyalty and duty to the United States become so obsolete that we would enshrine one who completely negates these principles? The very suggestion approaches blasphemy.

I have only the highest respect and admiration for the Air Force, Navy and civilian airmen who engaged in reconnaissance flights for the United States. At least 75 flight crewmen have given their lives for us while on reconnaissance and related missions; others have been captured by the Russians. In adversity these men have conducted themselves as men and as Americans, with the notable exception of Powers. To those nameless others I, too, owe a great deal; to Francis Powers I owe something also, and he has it in full measure—my contempt!

ARTHUR C. BROWN
Seattle, Wash.

As I read the first paragraph of Mr. Zawiski's letter to the editor declaring he felt it was time to "step out" and say what many Americans are thinking, I was elated to think he was going to write of Francis G. Powers in the true light. As I read on, I was disappointed. Allow me to "step out."

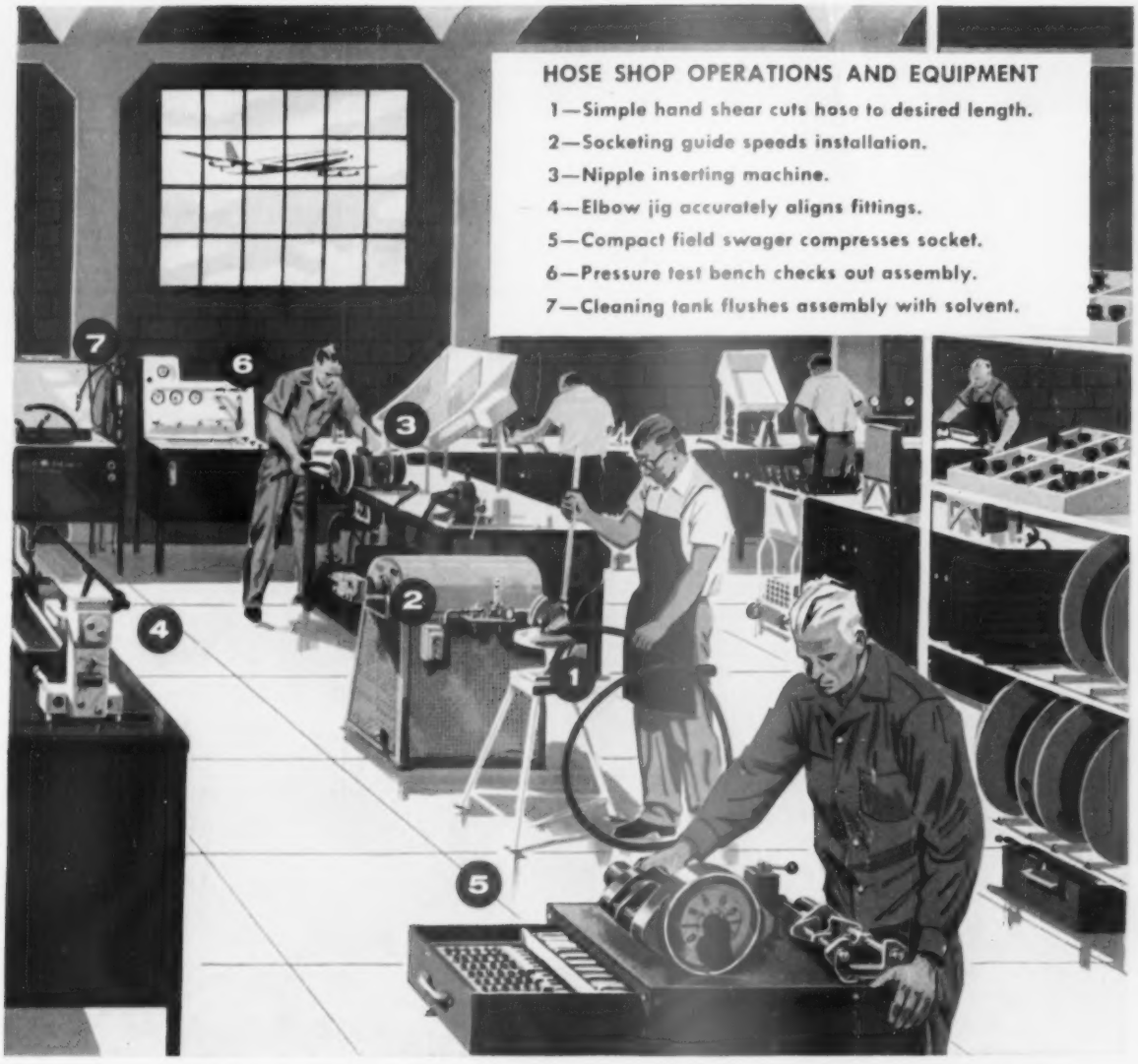
I am an American, a military man, and an aviator. I wish to place strict emphasis on that declining order in respect to importance and allegiance, for in my opinion this order was not clearly defined in the case of Francis G. Powers.

In reply to Mr. Zawiski's letter, I think Mr. Khrushchev has been quite adequately informed as to what Americans really think of men like Powers, and I am sure he would be astonished if an award was given to an individual or group for a significant achievement in aerial reconnaissance in dedication to this man.

The reasons set forth by Mr. Zawiski for a Francis G. Powers award are equally astonishing. The first was that we should not forget that Powers is imprisoned in Russia. As if the Communists would let us forget, as they continue to sway minds away from countries that would, in the words of Powers, "order" civilians to fly spy flights. The second reason set forth was to let Russians know there are Americans who believe in standing firm for the rights and privileges of free men. I am certain the Communists are aware of the Americans' ability and desire to resist aggression, but how convinced can they and the rest of the world be of the strength behind this desire when one of us loses sight of his moral obligation to this country?

I, too, am indebted to the men who fly the reconnaissance mission and develop the reconnaissance vehicles for their job is important and dangerous. I know from experience that their reward is also great in the knowledge that they are doing what they can to keep America free. A Francis G. Powers award would be a poor tribute to that faith.

MICHAEL G. BONI
Milton, Fla.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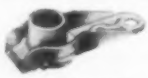
LHTA517 (NAS 687)	 LHTA517-2860	LHHA3575	
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